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CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, NEW JERSEY

FINAL RISK ASSESSMENT REPORT OPERABLE UNIT 4: BOUND BROOK

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ABS-d	dermal absorption factor
ADAF	age-dependent adjustment factor
AF	soil or sediment to skin adherence factor
AF_{Pb}	absolute gastrointestinal absorption fraction for ingested lead in soil
ALM	Adult Lead Model
AMNET	Ambient Biomonitoring Network
ANCOVA	analysis of covariance
ASI	Aqua Survey, Inc.
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	area use factor
AVS	acid volatile sulfide
B	ratio of permeability coefficient of a chemical through the stratum corneum of the skin relative to its permeability coefficient across the viable epidermis of the skin
BAF	bioaccumulation factor
BB	Bound Brook
bgs	below ground surface
BHHRA	baseline human health risk assessment
BKSF	biokinetic slope factor
BMF	biomagnification factor
BNA	base-neutral acid (extractable compounds)
BSAF	biota-sediment accumulaiton factor
BW	body weight
CalEPA	California Environmental Protection Agency
CBR	critical body residue
CDE	Cornell-Dubilier Electronics
CA	concentration in air
C_{diet}	concentration in dietary food type
CF	conversion factor
C_{fish}	concentration in fish
CFR	Code of Federal Regulations
cfs	cubic feet per second

C_{inv}	concentration in invertebrates
cis-1,2-DCE	cis-1,2-dichloroethene
CL	cooking loss
CLP	Contract Laboratory Program
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CR	contact rate
C_{sed}	concentration in sediment
C_{soil}	concentration in floodplain soil
CSEM	conceptual site exposure model
CSF	cancer slope factor
CTE	central tendency exposure
C_w	concentration in surface water
DA_{event}	dermally absorbed dose per event
DAD	dermally absorbed dose
DDD	4,4'-dichlorodiphenyldichloroethane
DDE	4,4'-dichlorodiphenyldichloroethylene
DDT	4,4'-dichlorodiphenyltrichloroethane
DI	daily intake
EC	exposure concentration
Eco-SSL	ecological soil screening level
ED	exposure duration
EF	exposure frequency
EPC	exposure point concentration
EPC_{Pb}	soil lead concentration
ERA	ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERED	Environmental Residue-Effects Database
ERT	Emergency Response Team
ESL	ecological screening level
ESV	ecological screening value

ET	exposure time
EU	exposure unit
EV	event frequency
FA	fraction absorbed
FCF	fish condition factor
foc	fraction organic carbon
FI	fraction ingested
FS	feasibility study
GB	Green Brook
$GSD_{i,adult}^{1.645}$	estimated value of the individual geometric standard deviation; the exponent is the value of the standard normal deviate used to calculate the 95th percentile from a lognormal distribution of PbB concentrations
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
HMW	high molecular weight
IBI	Index of Biotic Integrity
IEUBK	Integrated Exposure Uptake Biokinetic (Model for Lead in Children)
IR-Inv	ingestion rate of invertebrates
IR-F	ingestion rate of fish
IR-S	ingestion rate of floodplain soil
IR-Sed	ingestion rate of sediment
IRIS	Integrated Risk Information System
Kp	permeability coefficient
Koc	organic carbon partition coefficient
LMW	low molecular weight
LOAEL	lowest observable adverse effects level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NOAEL	no observable adverse effects level
NPL	National Priorities List
OU	operable unit
PAH	polycyclic aromatic hydrocarbon

PbB	blood lead level
$PbB_{adult,central}$	central estimate of blood lead concentrations in adults
$PbB_{adult,0}$	typical blood lead concentration in adults
PbB_{child}	geometric mean blood lead concentration in children
$PbB_{fetal,0.95}$	goal for the 95th percentile blood lead concentration among fetuses born to women having exposures to the specified lead concentration
PbB_t	target blood lead concentration
PCB	polychlorinated biphenyl
PEF	particulate emission factor
PF	proportion of food type in the diet
PPRTV	provisional peer-reviewed toxicity value
ProUCL	ProUCL®4.1.00
$R_{fetal/maternal}$	constant of proportionality between fetal PbB concentration at birth and maternal PbB concentration
RAGS	Risk Assessment Guidance for Superfund
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RM	river mile
RME	reasonable maximum exposure
ROD	record of decision
RSL	regional screening level
SA	skin surface area
SAV	submerged aquatic vegetation
SEM	simultaneously extracted metals
SI	site investigation
Site	Cornell-Dubilier Electronics Superfund Site
SL	Spring Lake
SQB	sediment quality benchmark
Study Area	OU4 Bound Brook Study Area
SVOC	semi-volatile organic compound
TAL	target analyte list
t*	time to reach steady-state

t-event	event duration
T-event	lag time per event
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethylene; trichloroethene
TCL	target compound list
TEF	toxic equivalence factor
TEQ	toxic equivalence
TOC	total organic carbon
trans-1,2-DCE	trans-1,2-dichloroethene
TRV	toxicity reference value
UCL	upper confidence limit
URF	unit risk factor
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VF	volatilization factor
VOC	volatile organic compound
WHO	World Health Organization
WQB	water quality benchmark

Executive Summary

This risk assessment was conducted to support the Remedial Investigation/Feasibility Study (RI/FS) for the Operable Unit 4 (OU4[1]) Bound Brook Study Area (Study Area) at the Cornell-Dubilier Electronics (CDE) Superfund Site (Site[2]) in Middlesex County, New Jersey. This report comprises the Baseline Human Health Risk Assessment (BHHRA) and Ecological Risk Assessment (ERA) for the OU4 Study Area.

The OU4 Study Area includes over eight miles of Bound Brook, a section of Green Brook downstream of its confluence with Bound Brook, portions of Cedar Brook (the largest tributary to Bound Brook), Spring Lake (an impoundment on Cedar Brook), and two other unnamed tributaries to Bound Brook. Analytical results from the RI for the OU4 Study Area (hereinafter referred to as the OU4 RI) revealed the presence of polychlorinated biphenyl (PCB) contamination in the sediments of Bound Brook, generally extending from the upstream boundary of the property known as the former CDE manufacturing facility (former CDE facility) in South Plainfield, New Jersey to the dam at the downstream end of New Market Pond in Piscataway, New Jersey (a distance of approximately 3.3 miles along Bound Brook). PCB Aroclor 1254 concentrations ranged from a maximum detection of 85 milligrams per kilogram [(mg/kg, or parts per million (ppm)] in the vicinity of the former CDE facility to approximately 4.4 mg/kg in New Market Pond. Concentrations downstream of the New Market Pond dam decreased markedly to approximately 0.23 mg/kg at the confluence with Green Brook; concentrations in Green Brook ranged from non-detected to 0.16 mg/kg. These findings are consistent with prior United States Environmental Protection Agency (USEPA) sampling of Bound Brook; however, the majority of the sediment samples analyzed previously were collected in the vicinity of the former CDE facility.

The former CDE facility is located at 333 Hamilton Boulevard, South Plainfield, New Jersey and is bordered by Bound Brook to the northeast and southeast. Between 1936 and

[1] Consistent with the OU4 RI Report, "OU4" refers to the geographic extent of the Bound Brook and Green Brook contamination and associated investigation; this area is also referred to as the "OU4 Study Area" or simply "Study Area."
[2] The "Site" refers to all four OUs which comprise the CDE Superfund Site, and the extent of each OU investigation.

1962, CDE manufactured electronic components, including PCB-containing capacitors. It has been reported that the company also tested transformer oils for an unknown period of time. PCBs and chlorinated organic degreasing solvents were used in the manufacturing process, and the company released PCB-contaminated material and trichloroethene directly onto facility soils during its operations. Since then, discarded capacitors have also been found during Site investigations, buried in the banks of Bound Brook proximal to the former CDE facility. Suspected contaminant transport pathways between the former CDE facility and Bound Brook include direct (historical) discharge from storm drains during operation of the former CDE facility, historical transport of contaminated soil from the former CDE facility as runoff, and releases associated with the burial of waste (including waste capacitors) in the banks of Bound Brook. The primary Site-related contaminants are PCBs and chlorinated volatile organic compounds (VOC).

A river mile (RM) system was developed for the OU4 RI, with RM0 placed at the confluence of Bound Brook and Green Brook. This system was used to position OU4 RI sampling locations, reference historical sampling locations, and describe the location of prominent Site features. As determined by the USEPA, the upstream extent of the Study Area is at RM8.3 near the Talmadge Road Bridge on Bound Brook in Edison, New Jersey, and the downstream extent is at RM-1.6 near the Shepherd Avenue Bridge on Green Brook in Bridgewater, New Jersey. The Green Brook portion of the OU4 Study Area was added after the RM numbering scheme had been established, hence the negative RM notation. The northern extent of the Study Area on Cedar Brook is Cedar Brook Avenue in South Plainfield, New Jersey.

Specifically, the OU4 Study Area included:

- Surface water and sediments in the main waterway channel from RM-1.6 to RM8.3, plus the three major tributaries to Bound Brook: the unnamed tributary near New Brunswick Avenue (confluence at RM4.7), unnamed tributary near Elsie Avenue (confluence at RM5.5), and Cedar Brook. Minor tributaries, ditches, and culverts are within the OU4 Study Area but were not investigated under the RI.

- Floodplain soils (proximally within the 100-year floodplain) from RM-1.6 to RM7.4 located mainly on public lands adjacent to Bound Brook and accessible for sampling. Floodplain soils, tributaries, and wetlands upstream of RM7.4 are being investigated under the Woodbrook Road Dump Superfund Site (Woodbrook Site).

The purpose of the risk assessment was to provide an evaluation of potential human and ecological health risks, currently and in the future, in the absence of any major action to control or mitigate surface water, sediment, groundwater[3]/porewater, floodplain soil, and biota contamination (*i.e.,* baseline risks). The risk assessment was based on the analytical results (chemical and other testing data) of environmental samples collected during many different Site investigations, starting with sampling in 1997 for the USEPA's Ecological Evaluation (USEPA, 1999a) and extending through 2013 when sampling for the OU4 RI was completed. Historical sediment, floodplain soil, biota (*e.g.,* fish, crayfish, and mouse tissue), and toxicity testing data were combined with OU4 RI data (*i.e.,* sediment, floodplain soil, and toxicity and bioaccumulation testing) to form data sets used in the risk assessment. Although historical surface water data are available, only the OU4 RI surface water data were used in the risk assessment, as they represent the most recent samples and span the entire Study Area. The risk assessment also incorporated OU4 RI sediment porewater data and sediment, floodplain soil, and sediment toxicity and sediment and soil bioaccumulation testing data from the OU4 Study Area and two reference areas (*i.e.,* Ambrose Brook and Lake Nelson) selected for the ERA.

Due to the large number of available sediment and floodplain soil samples, and because the nature and extent of chemical contamination throughout the nearly ten mile long Study Area is not homogeneous, multiple exposure units (EU) were established for the risk assessment. EUs were based on physical features of the Site and Bound Brook system and historic PCB concentrations, with boundaries adjusted to key landmarks. The

[3] Groundwater data were not evaluated in this risk assessment. However, per the Record of Decision (ROD) for OU3 (Groundwater), groundwater discharge to Bound Brook is addressed by the OU4 RI. Sediment porewater samples were collected during the OU4 RI to evaluate the potential for groundwater discharge to Bound Brook, and the porewater data were evaluated in this risk assessment.

potential for adverse human and ecological health effects was evaluated using data sets specific to each EU, to facilitate decisions regarding potential remedial actions.[4]

The OU4 Study Area was separated into eight EUs, as follows:

- Green Brook (GB) – applies to the 1.6-mile long portion of the Green Brook channel and its 100-year floodplain, from the Shepherd Avenue bridge over Green Brook at RM-1.6, upstream to the confluence with Bound Brook at RM0.
- Bound Brook 1 (BB1) – applies to the Bound Brook channel and its 100-year floodplain, from the confluence with Green Brook at RM0, upstream to the spillway of New Market Pond at RM3.43.
- Bound Brook 2 (BB2) – applies to New Market Pond and its 100-year floodplain, from Bound Brook RM3.43, upstream to the eastern end of New Market Pond at RM4.09.
- Bound Brook 3 (BB3) – applies to the Bound Brook channel and its 100-year floodplain, from the eastern end of New Market Pond at RM4.09, upstream to the Clinton Avenue bridge at RM5.22.
- Bound Brook 4 (BB4) – applies to the Bound Brook channel and its 100-year floodplain, from the Clinton Avenue bridge at RM5.22, upstream to the Lakeview Avenue bridge at RM6.18 and approximately 500 feet of the Cedar Brook channel and its 100-year floodplain upstream to Veterans Memorial Park/near the spillway bridge to Spring Lake.
- Bound Brook 5 (BB5) – applies to the Bound Brook channel and its 100-year floodplain, from the Lakeview Avenue bridge at RM6.18, upstream to the Belmont Avenue bridge at RM6.82. The former CDE facility is adjacent to BB5.

[4] Surface water and sediment porewater data, however, were not separated into data sets by EU because these data represent dynamic systems. Risks/hazards to human receptors for the surface water pathway were added to those estimated by EU for the other exposure pathways, to arrive at total risks/hazards for each EU. Ingestion of surface water for drinking was included in estimates of total intake for ecological receptors in each EU.

- Bound Brook 6 (BB6) – applies to the Bound Brook channel, from the Belmont Avenue bridge at RM6.82, upstream to the Talmadge Road bridge at RM8.3. From RM6.82 upstream to RM7.4, the Study Area includes the 100-year floodplain. From RM7.4 upstream to RM8.3, the Study Area includes only the channel (surface water and sediment).
- Spring Lake (SL) – applies to Cedar Brook, from north of Veterans Memorial Park/near the spillway bridge to Spring Lake.

Due to differences in assumptions regarding the potential for exposure, available sediment data were further separated into two data sets within each EU: Surface Sediment and All Sediment. With two exceptions[5], Surface Sediment samples were considered to be any sediment sample collected from a depth starting at 0 centimeters (cm). The All Sediment data set consisted of all sediment samples, regardless of depth. Similarly, available floodplain soil data were separated into two data sets within a given EU: Surface Soil and All Soil. Surface Soil samples were considered to be any soil sample collected from a depth starting between the surface (0 cm) and 30 cm below ground surface. The All Soil data set consisted of all soil samples, regardless of depth. Other than sample depth, no physical or chemical parameters were evaluated to define the Surface Sediment/Soil and All Sediment/Soil data sets.

Biota data used in the quantitative risk assessment were from fish (*i.e.,* fillet or whole body), crayfish, freshwater Asiatic clam, and white-footed mouse samples. A statistical evaluation of the biota data was performed to evaluate temporal and spatial patterns in total PCB concentrations and to assist in determining whether data collected at different stations throughout the Study Area were statistically significantly different or not. The evaluation confirmed that total PCB concentrations in fish samples collected during two separate investigations (*i.e.*, 1997 and 2008) were not statistically significantly different and therefore fillet samples from 1997 and 2008 could be combined and whole body samples from 1997 and 2008 could be combined. However, total PCB concentrations in predatory fish and bottom-feeding fish, in both fillet and whole body samples, were statistically significantly different. Therefore, fillet fish and whole body fish samples

[5] The Surface Sediment data set also included two low resolution core samples collected at depths of 3-16 cm and 10-14 cm below the sediment-water interface.

were separated into two data sets according to species: predatory fish (*i.e.*, pumpkinseed and bluegill sunfish and smallmouth bass) and bottom-feeding fish (*i.e.*, carp, white sucker, and brown bullhead catfish). Based on additional comparisons, biota samples collected from different stations were grouped into single data sets, where mean total PCB concentrations were not statistically different between sample populations. The data groupings and EU(s) to which they applied depended on the particular biota type evaluated.

Baseline Human Health Risk Assessment

The potential for adverse human health effects was expressed as incremental lifetime cancer risks and non-cancer hazards that were based on assumptions regarding the potential for exposure to chemicals detected in sampled environmental media, the estimated concentration of each chemical of potential concern (COPC) at the point of human contact, and the toxicity of each COPC. The BHHRA followed guidance outlined in the USEPA's *Risk Assessment Guidance for Superfund*: *Volume I, Human Health Evaluation Manual (Part A)* (USEPA, 1989) and other relevant USEPA guidance. As such, the BHHRA consisted of the following four parts: data evaluation, exposure assessment, toxicity assessment, and risk characterization (USEPA, 1989; NRC, 1983).

Data Evaluation

The risk assessment data sets for surface water, sediment (*i.e.,* Surface Sediment and All Sediment), floodplain soil (*i.e.,* Surface Soil and All Soil), fish fillet (*i.e.,* predatory fish fillet and bottom-feeding fish fillet), and shellfish (*i.e.,* Asiatic clams and crayfish) were used in the quantitative assessment of the potential for human health risks. To focus the BHHRA on those chemicals that, if contacted, have the greatest potential to pose human health risks, the list of detected chemicals in each data set and EU, as applicable, was narrowed to a list of COPCs. The COPC selection process was based primarily on comparison of maximum detected concentrations to USEPA Regional Screening Levels but included other selection criteria as well.

Table ES-1 presents a summary of the COPCs in each data set/EU and thereby identifies the detected chemicals that were evaluated further in the BHHRA.

Exposure Assessment

Representative exposure point concentrations (EPC) to be used in the calculation of incremental lifetime cancer risks and non-cancer hazards were estimated for each COPC. Concentrations in potential exposure media (*e.g.,* sediment, floodplain soil, and fish) were calculated to evaluate human exposure through the potential pathways and routes outlined in the Conceptual Site Exposure Model. This model describes the scenario timeframe, exposure medium, exposure point, and the exposure pathways and routes through which human receptors may be exposed to COPCs originating from the former CDE facility.

Based on the current and reasonably anticipated future land uses in the OU4 Study Area, the following human receptor populations and exposure scenarios (*i.e.*, combination of exposure pathways and routes for each potential receptor population) were evaluated:

- Recreationists/Sportsmen/Anglers[6]: [adults and adolescents (7-18 years old)] who may wade, fish, or otherwise recreate in the Study Area. Potential exposure pathways and routes of exposure included dermal contact with COPCs in surface water; incidental ingestion of and dermal contact with COPCs in Surface Sediment and Surface Soil; inhalation of volatile COPCs that may be released from surface water to outdoor air; and inhalation of particulate COPCs that may be released from Surface Soil to outdoor air.
- Anglers: [adults, adolescents (7-18 years old), and children (0-6 years old)] who may consume locally-caught fish fillet or shellfish (*i.e.,* clams and crayfish). This exposure route was in addition to those already identified for angler adults and adolescents, above. It was assumed adult and adolescent receptors may engage in fishing, clamming, or crabbing and thereby be exposed to COPCs in surface water, sediment, and Surface Soil, but children (0-6 years old) are only likely exposed to COPCs originating from the former CDE facility through consumption of locally-caught fish or shellfish in the household.

[6] A distinction was made between sportsmen who fish and release their catch, and anglers who may consume their catch.

- Outdoor Workers: (adults) who may work to maintain, repair, and/or clean culverts, spillways, bridges, and other structures in the Study Area. Potential exposure pathways and routes of exposure included dermal contact with COPCs in surface water; incidental ingestion of and dermal contact with COPCs in All Sediment and All Soil; inhalation of volatile COPCs that may be released from surface water to outdoor air; and inhalation of particulate COPCs that may be released from All Soil to outdoor air.
- Residents[7]: [adults and children (0-6 years old)] who live within or near the 100-year floodplain areas included in the Study Area. Potential exposure pathways and routes of exposure included incidental ingestion of and dermal contact with COPCs in All Soil and inhalation of wind-generated particulates released from All Soil to outdoor air.
- Commercial/Industrial Workers: (adults) who primarily work outdoors on commercial/industrial properties located within the 100-year floodplain areas included in the Study Area. Potential exposure pathways and routes of exposure included incidental ingestion of and dermal contact with COPCs in Surface Soil and inhalation of wind-generated particulates released from Surface Soil to outdoor air.
- Construction/Utility Workers: (adults) who may perform short-term intrusive work for construction or utility installation, maintenance, or repair within the Study Area. Potential exposure pathways and routes of exposure included incidental ingestion of and dermal contact with COPCs in All Soil and inhalation of mechanically-generated particulate COPCs released from All Soil to outdoor air.

All of these potential exposure scenarios may be occurring currently and may occur or continue to occur in the foreseeable future, in each EU. However, floodplain soil and crayfish data were not available for EU SL. Therefore, the potential for adverse health

[7] While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

effects from human exposure to COPCs in floodplain soil and crayfish were not evaluated for EU SL.

To evaluate ingestion and dermal contact exposures, EPCs for COPCs in surface water, sediment, floodplain soil, and biota were calculated as the 95 percent upper confidence limit (95% UCL) on the arithmetic average concentration using the USEPA's ProUCL, Version 4.1.00 software. In cases where the 95% UCL concentration was greater than the maximum detected concentration, and for chemical data sets with less than four samples or more than 70% non-detected results, the maximum concentration was retained as the EPC. To evaluate inhalation exposures to wind-generated respirable particulates that may be released from floodplain soil, concentrations of non-volatile COPCs in outdoor air were estimated using a particulate emission factor. To evaluate inhalation exposures for construction/utility workers who may be exposed to respirable particulates released from floodplain soil during the digging of a trench for construction/utility work, concentrations of non-volatile COPCs in outdoor air were estimated by calculating COPC-specific emission fluxes and predicting COPC concentrations using a screening-level atmospheric dispersion model.

USEPA-recommended equations and exposure parameter values were used to estimate human exposure in the form of daily chemical intakes, dermally absorbed doses, or exposure concentrations. These exposure estimates were then combined with chemical-specific toxicity information to estimate incremental lifetime cancer risks and non-cancer hazards. In accordance with USEPA guidance, estimates of reasonable maximum exposures (RME) and, where applicable, central tendency exposures (CTE) were generated. Use of RME parameter values simulates the highest exposure that might reasonably be expected to occur, one that is well above the average case but within the range of possibility, and results in upper-bound incremental lifetime cancer risks and non-cancer hazards.

Toxicity Assessment

Chemical-specific toxicity information is in the form of cancer potency slope factors or unit risk factors and non-cancer reference doses or reference concentrations. Toxicity values were obtained from the following hierarchy of sources recommended by the USEPA (2003c): USEPA's Integrated Risk Information System, USEPA's Provisional

Peer-Reviewed Toxicity Values, and additional sources, including but not limited to the California Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry.

The USEPA has not derived toxicity values for lead. Rather, the potential for adverse health effects from exposure to lead is evaluated through comparison of predicted blood lead (PbB) levels to a health-protective goal. The USEPA's stated goal for lead is that children have no more than a 5 percent probability of exceeding a PbB level of 10 µg/dL. As such, this level is assumed to also provide protection for adults.

The USEPA's Adult Lead Methodology (USEPA, 2003a) and Adult Lead Model (ALM) were used to evaluate lead exposures for the adult and adolescent recreationist/sportsman/ angler and resident populations, by modifying exposure parameter values input to the ALM and/or by adding a site-specific fish ingestion pathway, as applicable. The USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children was used to evaluate resident child exposure to lead in floodplain soil and locally-caught fish fillet or shellfish.

Risk Characterization

Individual (*i.e.,* COPC-specific) incremental lifetime cancer risks and non-cancer hazards were calculated for each potential human receptor population. Separate risk/hazard estimates were presented for each EU. Sources of uncertainty in the risk assessment process and characterization of whether the risks may be over- or under-estimated is presented in the Uncertainty Evaluation section of this report.

Individual incremental lifetime cancer risks are expressed as unitless probabilities (*e.g.,* 2E-06 or 2 in 1,000,000) of a person developing cancer. The individual cancer risks for each exposure scenario were summed to arrive at an estimate of the total cancer risk from exposure to multiple chemicals. For known or suspected carcinogens, the National Oil and Hazardous Substances Contingency Plan (NCP) (USEPA, 1990) established that acceptable exposure levels are generally concentration levels that represent an incremental upper-bound lifetime cancer risk in the range from 10^{-4} (*i.e.,* 1E-04 or 1 in 10,000) to 10^{-6} (*i.e.,* 1E-06 or 1 in 1,000,000) or less. The cancer risks estimated for each exposure scenario were compared to this risk range established by the NCP.

Non-cancer hazard is expressed as the unitless ratio, termed the hazard quotient (HQ), of the daily chemical intake or exposure concentration to the non-cancer reference dose or reference concentration. For systemic toxicants, the NCP established that "acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety" (USEPA, 1990). As the non-cancer toxicity values are protective of the potential for adverse, non-cancer health effects, HQs greater than 1E+00 indicate the potential for non-cancer hazard. The total individual non-cancer HQs were summed for each exposure scenario to yield hazard indices (HI) that reflect the potential for adverse, non-cancer health effects from exposure to multiple chemicals. For the non-cancer assessment, exposure scenarios with an HI greater than 1 (*i.e.,* 1E+00) are of potential concern.

Table ES-2 (RME) and Table ES-3 (CTE) present the incremental lifetime cancer risks and non-cancer hazards for each scenario evaluated in the BHHRA for OU4. Emphasis is placed on cancer risks and non-cancer hazards estimated using RME parameters, as evaluation of the RME scenario serves as the determination regarding remedial action.

As shown in Table ES-2, total cancer risks greater than the risk range established by the NCP (*i.e.,* greater than 1E-04) were estimated for the following receptor populations:

- Adult and adolescent recreationists/sportsmen at all of the EUs on Bound Brook (EUs BB1, BB2, BB3, BB4, BB5, and BB6). The cancer risks are attributable to benzidine in Surface Sediment.
- Adult and adolescent anglers at every EU in the Study Area. The cancer risks are predominantly attributable to benzidine in Surface Sediment and total PCB Aroclors and TCDD TEQ (PCBs)[8] in predatory or bottom-feeding fish fillet.
- Child anglers at every EU in the Study Area. The cancer risks are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet.
- Outdoor workers at EU BB3. The cancer risk is attributable to benzidine in All Sediment.

[8] TCDD TEQ (PCBs) refers to total PCB concentrations, evaluated in terms of tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence (TEQ).

- Adult and child residents at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The cancer risks are predominantly attributable to total PCB Aroclors in All Soil, but for adult residents at EU BB5, also to dieldrin in All Soil.

Cancer risks estimated for the above receptors at other EUs, for child anglers exposed to shellfish at all EUs in the Study Area, for commercial/industrial workers exposed to Surface Soil at all EUs, and for construction/utility workers exposed to All Soil at all EUs were less than or within the risk range established by the NCP. Cancer risks for adult and adolescent anglers were also less than 1E-04 for the shellfish ingestion pathway at all EUs in the Study Area; however, the total cancer risks for these receptors were greater than 1E-04 at most EUs due to contributions of cancer risk from exposure to COPCs in other environmental media.

The potential for adverse, non-cancer health effects was indicated for:

- Adult recreationists/sportsmen at EU BB5. The hazard is attributable to total PCB Aroclors in Surface Sediment.
- Adolescent recreationists/sportsmen at four EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The hazards are predominantly attributable to total PCB Aroclors in Surface Sediment and Surface Soil.
- Adult and adolescent anglers at every EU in the Study Area, from exposure to fish fillet or shellfish, predominantly, and exposure to Surface Sediment and Surface Soil as described above for recreationists/sportsmen. The hazards from exposure to fish fillet are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet, but at EU BB2, also to heptachlor epoxide in bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors in Asiatic clams or crayfish.
- Child anglers at every EU in the Study Area. The hazards from exposure to fish fillet are attributable to heptachlor epoxide, total PCB Aroclors, and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors and TCDD TEQ (PCBs) in Asiatic clams or total PCB Aroclors in crayfish.
- Outdoor workers at EU BB5. The hazard is attributable to total PCB Aroclors in All Sediment and All Soil.

- Adult residents at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6) and child residents at every EU except SL, for which floodplain soil data were not available. The hazards for the adult resident are attributable to total PCB Aroclors in All Soil, while hazards for the child resident are predominantly attributable to total PCB Aroclors, but at EU BB3, also to antimony, iron, and thallium in All Soil, and at EU BB5, also to dieldrin in All Soil.
- Adult commercial/industrial workers at EUs BB5 and BB6. The hazards are attributable to total PCB Aroclors in Surface Soil.
- Adult construction/utility workers at every EU in the Study Area, from inhalation exposure to manganese in All Soil.

The non-cancer hazards estimated for the above receptors at other EUs were less than 1.

The BHHRA confirms there is a potential for unacceptable cancer risk and non-cancer hazard from exposure to total PCB Aroclors in sediment, floodplain soil, fish, and shellfish that is relatively wide-spread throughout the Study Area. The non-cancer hazards from exposure to total PCB Aroclors in sediment was limited to EU BB5, but total PCB Aroclors in floodplain soil, fish fillet, or shellfish was the predominant contributor to a non-cancer HI greater than 1 for at least one receptor population at every EU. When evaluated as TCDD TEQ, PCBs in fish fillet or shellfish was the predominant contributor to an unacceptable cancer risk or non-cancer hazard for at least one receptor population at every EU.

Concentrations of other chemicals that were demonstrated to be predominant contributors to the unacceptable cancer risks and/or non-cancer hazards estimated in the BHHRA [and are therefore termed chemicals of concern (COC)] are not likely attributable to the former CDE facility. Heptachlor epoxide was a COC in bottom-feeding fish fillet from EUs BB2, BB3, and BB4 and in predatory fish fillet from EU BB5. Dieldrin was a COC in All Soil at EU BB5. However, pesticide concentrations detected in fish fillet and floodplain soil samples are not likely attributable to operations at the former CDE facility. Antimony, iron, and thallium were COCs in All Soil at EU BB3, and manganese was a COC in All Soil at every EU in the Study Area except SL, for which floodplain soil data were not available. Antimony, manganese, and thallium are naturally occurring metals found at trace levels in the environment. Iron and manganese are essential nutrients. Detected concentrations of antimony, iron, and manganese in All Soil were generally comparable to those detected in reference area soil samples and may therefore reflect background conditions, except for at EU BB3, where maximum concentrations were well outside the range of reference area concentrations. Thallium was not detected in reference area soil samples. However, typical thallium concentrations in soil are 0.3 – 0.7 mg/kg (ATSDR, 1992b) and thallium concentrations detected in All Soil at EU BB3 ranged from 0.56 – 4.0 mg/kg.

The exposure modeling conducted to evaluate exposures to lead only indicated a potential for elevated PbB (*i.e.,* greater than 10 µg/dL) for outdoor workers, construction/utility workers, and child residents exposed to All Soil at EU BB3. The modeled EPC (based on the arithmetic average concentration) was influenced by three relatively elevated observations that are statistical outliers in the data set. Therefore, the potential for elevated PbB may be localized to one or more locations within EU BB3.

The source of elevated metals concentrations in floodplain soil at EU BB3 is not known. Regardless, metals are not contaminants associated with the former CDE facility.

Ecological Risk Assessment

The overall goal of ERA is to evaluate whether adverse effects to ecological receptors (*i.e.,* organisms and their respective habitats) are occurring or may occur as a result of exposure to one or more stressors. The ERA served to update and refine the USEPA’s 1997 Ecological Evaluation and 2008/2009 Reassessment.

The ERA consisted of a screening-level evaluation and baseline ERA, and as such, incorporated components of Steps 1 through 8 of the USEPA’s Ecological Risk Assessment Guidance for Superfund (ERAGS) (USEPA, 1997 and updates).

The objectives of the ERA were to:

- Identify and characterize existing ecological resources/habitats and resource values (quality/quantity of the resources) within the Study Area.
- Identify biological receptors that may utilize affected habitats within the Study Area.

- Evaluate the potential acute, chronic or bioaccumulation effects resulting from exposure to contamination related to the former CDE facility within the Study Area, currently and in the future in absence of remedial action.

- Provide a basis to evaluate the ecological suitability/impacts of selected remedial alternatives with respect to both short-term and long-term successes.

Problem Formulation

Appropriate assessment and measurement endpoints were selected based on the environmental setting and ecological conceptual site model. Ecological receptors potentially exposed to chemicals of potential ecological concern (COPECs) in surface water and sediment, currently and in the foreseeable future, include:

- Aquatic plants, benthic invertebrates, freshwater fish, semi-aquatic birds and mammals, and reptiles and amphibians potentially exposed to COPEC in surface water, porewater, and/or sediment and bioaccumulated into dietary items.

- Terrestrial birds and mammals that may use Bound Brook and its tributaries and impoundments as a water source.

Ecological receptors potentially exposed to COPEC in floodplain soil, currently and in the foreseeable future, include:

- Terrestrial plants, soil invertebrates, birds, mammals, reptiles, and amphibians potentially exposed to COPEC in floodplain soil and bioaccumulated into dietary items.

Ecological receptors are exposed to COPEC in abiotic media through direct contact (including respiration for fish) and both intentional (*e.g.,* drinking surface water) and incidental (*e.g.,* soil or sediment entrained in dietary items) ingestion. Ecological receptors are exposed through intentional ingestion of COPEC bioaccumulated into the plant and animal tissues that make up their diets.

Overall, assessment endpoints are any adverse effects on ecological receptors, (*i.e.,* plant and animal populations and communities) that may be present in or utilize the stream channel or adjacent floodplains within the Study Area. The overall structure and function of the stream corridor, including New Market Pond, and Spring Lake, and adjacent floodplains within the OU4 Study Area, was assessed through the following community-based and population-based assessment endpoints.

Community-Based Assessment Endpoints

- Benthic invertebrate community - long-term maintenance of survival, growth, and reproduction of the benthic invertebrate community.
- Aquatic life community – long-term maintenance of survival, growth, and reproduction of the aquatic life community, and in particular the fish community.
- Terrestrial plant community - long-term maintenance of a healthy and diverse plant community. Plants are primary producers, provide a critical food source, and are the first link in the terrestrial food chain for higher trophic level consumers. In addition, vegetation provides critical habitat for wildlife. Plants that occur in the floodplains are woody and herbaceous species that could serve as a food source and cover for songbirds and small herbivores.
- Soil invertebrate community - long-term maintenance of survival, growth, and reproduction of the soil invertebrate community. Invertebrates present in surface soil within the floodplains provide a source of food for ground gleaning birds and small mammals. They also play a vital role in the ecosystem as primary and secondary decomposers.

Population-Based Assessment Endpoints

- Semi-aquatic bird and mammal populations - long-term maintenance of the survival, growth, and reproduction of semi-aquatic bird and mammal populations within several feeding guilds that inhabit/utilize the stream corridor.
- Terrestrial bird and mammal populations - long-term maintenance of the survival, growth, and reproduction of terrestrial bird and mammal populations within several feeding guilds that inhabit/utilize mainly the floodplains of the stream corridor.

The following wildlife species were selected as representative of semi-aquatic herbivorous, insectivorous, omnivorous, and piscivorous birds and mammals and terrestrial herbivorous, insectivorous, omnivorous, and carnivorous birds and mammals which have been documented or are likely to be present within the OU4 Study Area.

Feeding Guild	**Representative Species**
Semi-Aquatic Feeding Guilds	
Herbivorous Bird	Wood duck
Insectivorous Bird	Mallard, red-winged blackbird
Piscivorous Bird	Great blue heron, belted kingfisher
Herbivorous Mammal	Muskrat
Insectivorous Mammal	Raccoon, Little brown bat
Piscivorous Mammal	Mink
Terrestrial Feeding Guilds	
Herbivorous Bird	Mourning dove
Insectivorous Bird	American robin
Carnivorous Bird	Red-tailed hawk
Herbivorous Mammal	Eastern gray squirrel
Insectivorous Mammal	Short-tailed shrew
Carnivorous Mammal	Red Fox

For the community-based assessment, measured chemical concentrations in abiotic media in conjunction with media screening concentrations protective of receptors in direct contact with those media were used as measurement endpoints for one line of evidence in evaluating the potential for adverse effects to benthic invertebrates, aquatic life, and terrestrial plants and invertebrates. Measured chemical concentrations in biota tissue in comparison to critical body residues provided an additional line of evidence in evaluating the potential for adverse effects to benthic invertebrates and fish. Finally, sediment toxicity testing and estimated chemical concentrations in fish eggs in comparison with critical fish egg residues provided a third line of evidence for benthic invertebrates and fish.

For the population-based assessment, food web accumulation modeling was used in conjunction with toxicity reference values as measurement endpoints for representative wildlife species within the selected semi-aquatic and terrestrial feeding guilds. Estimated chemical concentrations in bird eggs in comparison with critical avian egg residues provided an additional line of evidence for semi-aquatic birds.

Screening-Level Exposure and Effects Analysis

Part of the exposure and effects analysis is to select COPECs and determine appropriate EPCs to which receptors may be exposed. COPECs were first selected based on comparison of chemical concentrations in abiotic media to ecological screening values (ESV). All usable data for abiotic media including: surface water, sediment (*i.e.,* Surface Sediment), and floodplain surface soil (*i.e.,* Surface Soil), were summarized and used in the screening-level exposure and effects evaluation. The HQ approach *(i.e.,* ratio of maximum detected concentration to ESV) was used in a screening-level risk calculation step to determine which detected chemicals pose the potential for adverse effects in ecological receptors. Chemicals with an HQ greater than 1 were selected as COPECs. Chemicals for which ESVs are not available were also selected as COPECs. Chemicals considered essential macronutrients (*i.e.,* calcium, magnesium, potassium, and sodium) were eliminated as COPECs. The screening-level COPECs are shown in Table ES-4.

COPEC Refinement

The lists of COPECs in abiotic media for each EU were refined, following USEPA guidance (2001a), for consideration in the baseline portion of the ERA. Frequency of detection and concentration, comparison to reference areas, and bioaccumulation potential were used to refine the lists of COPECs. The refined COPECs are shown in Table ES-5.

Baseline Exposure and Effects Analysis

The baseline exposure and effects analysis evaluated exposure to ecological receptors and identified measures of toxicity used to characterize the potential for adverse effects for the measurement endpoints. Multiple lines of evidence were evaluated, relying on EPCs in surface water, porewater, surface sediment, floodplain soil, and biota to assess:

- direct exposures to primary and secondary trophic level receptors (*e.g.,* aquatic invertebrates, fish, terrestrial plants, and soil invertebrates) which were evaluated via a direct comparison of EPCs to ecological benchmarks in the exposure medium protective of exposure of these organisms;

- bioaccumulation into tissues of secondary trophic level organisms, and

- food-web transfer of bioaccumulative COPECs to higher trophic level organisms, in which EPCs for abiotic and biotic exposure media were used in comparison to critical body residues and as inputs to food web exposure models.

EPCs were calculated as the lower of the maximum detected concentration or the 95% UCL on the arithmetic average concentration for the refined COPECs using the risk assessment data sets. EPCs were determined for the risk assessment data sets for surface water, Surface Sediment, Surface Soil, whole body predatory and bottom-feeding fish, Asiatic clams, crayfish, and small mammals used to evaluate the potential for adverse health effects in ecological receptors. Concentrations of total PCBs in terrestrial earthworm tissue were estimated using EPCs in Surface Soil and a site-specific soil-to-earthworm bioaccumulation factor derived from the soil bioaccumulation tests. Estimated concentrations in earthworms were then used to evaluate dietary exposure in terrestrial food web models. Concentrations of refined COPECs in aquatic and terrestrial plants were estimated using EPCs in Surface Sediment or Surface Soil and literature-derived sediment-to-plant or soil-to-plant bioaccumulation factors. Estimated concentrations in plants were then used to evaluate dietary exposure in semi-aquatic and terrestrial food web models.

Toxicity Testing

The results of the acute and chronic whole sediment toxicity tests on *Hyalella azteca* and *Chironomus tentans* conducted during the OU4 RI were used as another line of evidence in assessing the potential for adverse effects to benthic invertebrates. Survival, growth, and reproduction results for locations within Bound Brook and New Market Pond were compared to results for reference locations.

Tissue Residue Evaluation

The residue-based evaluation provided additional lines of evidence in assessing the potential for adverse effects to benthic invertebrates, fish, and birds. The tissue residue evaluation was limited to bioaccumulative chemicals detected in fish and invertebrate tissue since this approach is most relevant to chemicals accumulated by aquatic biota via dietary and direct contact exposures (Suter, 2007). Measured concentrations in fish and invertebrate tissue and estimated fish and avian egg residues were compared to literature-derived critical body residues (CBRs).

Food Web Modeling Exposure Estimates

For the population-based assessment, intakes of bioaccumulative COPECs (in the form of a dose, in mg COPEC per kg body weight per day) based on total exposure from incidental ingestion of sediment/soil during feeding/foraging, nesting/burrowing, and/or preening activities, ingestion of surface water for drinking, and ingestion of dietary/prey items of each representative wildlife species were estimated.

Receptor dietary consumption was categorized into plants, invertebrates, fish, or prey (*i.e.,* small mammals) items. The exposure parameters (*i.e.,* food intake rates, proportion of soil in the diet, proportion of dietary items in diet, and body weight) necessary to calculate COPEC intakes for the representative wildlife receptor species were derived from literature. The home ranges were evaluated in relation to the area of each EU and area use factors were calculated by dividing the EU area by the home range size for each species. Based on the receptor home ranges and the EU areas, area use factors were applied to the food web modeling for the mallard, red-tailed hawk, mourning dove, and red fox.

Toxicity Reference Values

USEPA (2007g) defines wildlife TRV as a dose (based on laboratory toxicological investigations) above which a particular ecologically relevant effect may be expected to occur in an organism following chronic dietary exposure and below which it is reasonably expected that such effects will not occur. Both low (NOAEL; the no observed adverse effects level) and high (LOAEL; the lowest observed adverse effects level) TRVs were identified from literature sources for each COPEC for birds and mammals to bracket a threshold effect level. The NOAEL-based TRV represents a conservative dose level at or below which adverse effects are unlikely to occur. Conversely, the LOAEL-based TRV is a less conservative estimator of potential adverse effects, representing a dose level at which adverse effects may occur.

Risk Characterization

Risk characterization is the final phase of risk assessment in which the likelihood of adverse effects is evaluated by combining the analyses of exposure and effects. In this phase the likelihood of adverse ecological effects occurring is estimated. The HQ method was used for all lines of evidence except toxicity and bioaccumulation testing. The HQ is expressed as measure of exposure divided by measure of effect. The measures of exposure in the ERA include measured COPEC concentrations in abiotic and biotic media, estimated COPEC concentrations in biotic media, and estimated COPEC intakes in wildlife. The measures of effect are media-specific ESVs, CBRs, and wildlife TRVs. HQs for both low (NOAEL-based) and high (LOAEL-based) measures of effect (indicated as HQnoaels and HQloaels, respectively) were calculated for the tissue residue evaluation and the food web modeling. HQs are generally interpreted as follows:

- An HQnoael less than 1 indicates that toxicological effects and potential risk are likely not occurring.
- An HQnoael greater than 1 and an HQloael less than 1 indicates that toxicological effects and potential risk may occur.
- An HQloael greater than 1 indicates that toxicological effects and potential risk are more likely to occur.

Sources of uncertainty in the risk assessment process and characterization of whether the risks may be over- or under-estimated is presented in the Uncertainty Evaluation section of this report.

The following conclusions regarding the potential for adverse health effects from exposure to Site-related COPECs are made based on evaluation of the multiple lines of evidence for each assessment endpoint. For the lines of evidence that are comparison of abiotic media concentrations to ESVs, refined COPECs for which HQs are greater than 1 are summarized in Table ES-5. The HQs for the tissue residue evaluation are summarized in Table ES-6. The HQs for food web modeling are summarized in Tables ES-7 and ES-8 for semi-aquatic birds and mammals, respectively, and in Tables ES-9 and ES-10 for terrestrial birds and mammals, respectively. Results of toxicity and bioaccumulation testing are discussed separately.

Protection of Benthic Invertebrates

Based on concordance of the following lines of evidence, there may be a potential for adverse health effects in benthic invertebrates associated with exposure to Site-related COCs. These include cis-1,2-DCE in porewater and Surface Sediment at EU BB5 and PCBs in porewater in EU BB5 and Surface Sediment in EUs BB2, BB3, BB4, BB5, and BB6.

- Comparison of sediment/porewater data to screening concentrations protective of benthic invertebrates: Refined HQs greater than 1 for total PCB Aroclors in Surface Sediment at EUs BB2, BB3, BB4, BB5, and BB6, HQ greater than 1 for vinyl chloride in Surface Sediment at EU BB5, and HQs greater than 1 for cis-1,2-DCE and vinyl chloride in porewater all indicate a potential for adverse health effects in benthic invertebrates. However, as discussed in Section 6.3, comparison of concentrations of cis-1,2-DCE and vinyl chloride in Surface Sediment to modified SQBs indicate that cis-1,2-DCE is more likely to be associated with potential adverse health effects than vinyl chloride.

- Comparison of benthic invertebrate tissue data to invertebrate critical body residues: HQnoaels and HQloaels greater than 1 for crayfish and Asiatic clam tissue concentrations of total PCB Aroclors at all EUs indicate a potential for adverse health effects in benthic invertebrates.

- Evaluation of sediment toxicity tests: Results of long-term tests with H. Azteca where a 38 percent reduction in growth in BB-SD01 (EU BB5) and a 42 percent reduction in growth in BB-SD03 (EU BB1) compared to the corresponding reference sediment; results of short-term tests with C. dilutus where a 68 percent reduction in growth in BB-SD01 (EU BB5) and a 21 percent reduction in growth in NMP-SD01 (EU BB2) compared to the corresponding reference sediment; and results of long-term tests with C. dilutus where a 139 percent reduction in 20-day percent survival in BB-SD01 (EU BB5), a 153 percent reduction in total percent emergence in BB-SD01 (EU BB5), and a 70 percent reduction in total percent emergence in BB-SD03 (EU BB1) compared to the corresponding reference sediment all indicate a toxic effect.

- Evaluation of bioaccumulation tests: Results of a 28-day bioaccumulation test with L. variegates in Bound Brook sediments had higher BSAFs than test specimens in reference sediment; test specimens in New Market Pond sediments had lower BSAFs than test specimens in reference sediments; and test specimens exposed to EU BB1 sediments exhibited the greatest bioaccumulation.

Protection of Aquatic Life (Fish)

Based on concordance of the following lines of evidence, there may be a potential for adverse health effects in aquatic life associated with exposure to Site-related COCs.

- Comparison of surface water/porewater data to screening concentrations protective of aquatic life: HQs greater than 1 for 1,2-DCE, vinyl chloride, total PCB Aroclors, and TCDD TEQ (PCBs) in surface water/porewater indicate a potential for adverse effects in aquatic life.

- Comparison of fish tissue data to fish critical body residues: HQnoaels and HQloaels greater than 1 for predatory and bottom-feeding whole body tissue concentrations of total PCB Aroclors at all EUs indicate a potential for adverse health effects in aquatic life. However, as discussed in Section 6.3, FCFs are generally equal to or greater than 1 for fish in all EUs, indicating fish within the OU4 Study Area appear to be healthy.

- Comparison of estimated concentrations in fish eggs to critical egg residues: While an HQnoael of 2 for TCDD TEQ (PCBs) at EU BB5 indicates the potential for adverse effects for bottom-feeding fish eggs, the HQloael is less than 1. In addition, as discussed in Section 6.3, populations of fish within the OU4 Study Area appear to be maintained based on the evidence of piscivorous birds present in the area during the breeding season as documented by the New Jersey Audubon Society's breeding bird surveys.

Protection of Semi-Aquatic Birds and Mammals

Based on concordance of the following lines of evidence, dietary exposure to PCBs in some semi-aquatic birds and mammals may be associated with adverse health effects.

- Comparison of modeled intakes to toxicity reference values: Insectivorous and piscivorous receptors with HQnoael greater than 1 for total PCB Aroclors and TCDD TEQ (PCBs) in all EUs, with the highest HQs for belted kingfisher at EU BB5 and HQnoael and/or HQloael greater than 1 for total PCB Aroclors and TCDD TEQ (PCBs) at one or more EUs, with the highest HQs for American mink at EU BB5.

- Comparison of estimated concentrations in bird eggs to critical egg residues: HQnoaels and HQloaels for total PCB Aroclors and TCDD TEQ (PCBs) in bird eggs based on both predatory and bottom-feeding fish concentrations in all EUs, with the highest HQs at EU BB5.

Protection of Terrestrial Plants and Invertebrates

Based on lack of concordance of the following lines of evidence, it is not likely that PCBs in Surface Soil are associated with wide-spread adverse health effects in terrestrial plants and invertebrates throughout the Bound Brook floodplains. As discussed in Section 6.3, plant uptake of PCBs is considered to be negligible due to the large molecular weight and strong sorption of PCBs to organic matter (Bacci and Gaggi, 1985) and while accumulation in the tissues of soil invertebrates provides direct evidence of bioavailability, bioaccumulation alone is not an indication of adverse health effects.

- Comparison of floodplain soil data to screening concentrations protective of soil invertebrates: Total PCB Aroclors were selected as a refined COPEC in Surface Soil at EU BB6.

- Evaluation of soil bioaccumulation tests: Results of 28-day bioaccumulation test with E. fetida in Bound Brook soils had higher total PCB tissue residues than test specimens in the corresponding reference soil.

Protection of Terrestrial Birds and Mammals

Although considerable uncertainty is associated with literature-based ESVs, based on concordance of the following lines of evidence, dietary exposure to PCBs based on site-specific bioaccumulation in soil invertebrates may be associated with adverse health effects in terrestrial insectivorous birds and mammals.

- Comparison of floodplain soil data to screening concentrations protective of wildlife: HQs greater than 1 for total PCB Aroclors in Surface Soil at all EUs.
- Comparison of modeled intakes to toxicity reference values: HQnoael and HQloael greater than 1 for terrestrial insectivorous birds and mammals at EUs BB3, BB4, BB5, BB6, and SL.

Discussion of Ecological Risks for Non-Site-Related COPECs

The potential for adverse health effects in ecological receptors associated with exposure to COPECs that are not Site-related was discussed by chemical class.

Volatile Organic Compounds

Of the refined volatile COPECs that are not Site-related (Table ES-5), acetone (EUs BB1, BB2, BB3, BB4, BB5, BB6, and SL) and toluene (EU BB5) were detected in sediment at concentrations greater than the ESVs resulting in HQs greater than 1 and indicating a potential for adverse health effects in benthic invertebrates.

Semi-Volatile Organic Compounds

Seven SVOCs retained as refined COPECs (*i.e.*, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, diethylphthalate, 2-methylnaphthalene, 3-/4-methylphenol, and phenol) were detected in Surface Sediment and Surface Soil in one or more EUs at concentrations greater than the ESVs (HQs greater than 1) (Table ES-5), indicating a potential for adverse health effects in benthic invertebrates (Surface Sediment) or birds and mammals (Surface Soil).

Polycyclic Aromatic Hydrocarbons

Fifteen individual PAHs were retained as refined COPECs in sediment at multiple EUs throughout the OU4 Study Area (Table ES-5). Based on comparison of detected concentrations in Surface Sediment to ESVs protective of benthic invertebrates, resulting in HQs greater than 1, there is a potential for adverse health effects. Total HMW PAHs were retained as refined COPECs in Surface Soil based on comparison of detected concentrations to ESVs protective of plants and terrestrial invertebrates in EU BB5 and based on comparison of detected concentrations to ESVs protective of birds and mammals in all EUs (except EU SL, for which no floodplain soil data were available) (Table ES-5), indicating a potential for adverse health effects.

The nature and extent of PAH contamination in sediment within the OU4 Study Area was described in the RI report and determined to be widespread in surface sediment along Bound Brook from RM0 to RM7 where bridges, roads, and stormwater outfalls are located, and lower contamination levels observed upstream of RM7 and in Green Brook, where water ways are bordered by wetlands and undeveloped floodplain. Based on the evaluation presented in the RI report, the largest PAH inventory in sediments appear to be located from approximately RM2 to RM5.

While PAHs are bioaccumulative, they were not detected in biota tissue samples, where analyzed. Therefore, PAHs were not evaluated in the tissue residue evaluation or food web modeling for insectivorous, piscivorous, or carnivorous birds and mammals in the assessment. However, based on estimated PAH concentrations in aquatic plants and subsequent dietary exposure to higher trophic level organisms, herbivorous semi-aquatic mammals (*e.g.,* muskrat) may be at increased risk for adverse health effects from exposure to HMW PAHs bioaccumulated in plants within the OU4 Study Area (HQnoaels greater than 1, shown in Table ES-8).

Pesticides

Twelve pesticides (*i.e.,* alpha-BHC, beta-BHC, gamma-BHC, total chlordane, dieldrin, total DDx, alpha- and beta-endosulfan, endrin, heptachlor, heptachlor epoxide, and methocxychlor) were retained as refined COPECs in Surface Sediment in one or more EUs (including EUs BB1 through BB6 and SL) based on comparison of detected concentrations to ESVs protective of benthic invertebrates (Table ES-5), indicating a potential for adverse health effects. Only total DDx and heptachlor epoxide were detected in biota tissue samples (whole body predatory fish only). Based on tissue residue evaluation for whole body predatory fish (Table ES-6), the bird egg residue evaluation (Table ES-6), and food web modeling for semi-aquatic piscivorous birds and mammals (*i.e.*, great blue heron, belted kingfisher, and American mink) (Tables ES-7 and ES-8), and omnivorous mammals (*i.e.*, raccoon) (Table ES-8), it is unlikely that exposure to total DDx or heptachlor epoxide is associated with adverse health effects in aquatic life (fish) or semi-aquatic birds or mammals within the OU4 Study Area (all HQs less than 1).

Seventeen pesticides were included as refined COPECs for evaluation of herbivorous semi-aquatic wildlife. Based on estimated pesticide concentrations in aquatic plants and subsequent dietary exposure to higher trophic level organisms, terrestrial herbivorous mammals may be at increased risk for adverse health effects from exposure to dieldrin at EUs BB5 and BB6, beta-endosulfan at EU BB5, and endrin at EUs BB4 and BB5 within the OU4 Study Area (HQnoael greater than 1 for muskrat shown in Table ES-8).

Of the pesticides detected in Surface Soil, only aldrin was detected at concentrations greater than the ESVs protective of plants and invertebrates (Table ES-5), indicating a potential for adverse health effects. Seven pesticides (*i.e.,* dieldrin, total DDx, beta-endosulfan, endrin aldehyde, heptachlor, heptachlor epoxide, and methoxychlor) were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals (Table ES-5). Of these, only dieldrin, total DDx, and heptachlor epoxide were detected in mouse tissue samples. Based on food web modeling for terrestrial carnivorous birds and mammals (*i.e.*, red-tailed hawk and red fox), it is unlikely that exposure to dieldrin or heptachlor epoxide is associated with adverse health effects in terrestrial birds or mammals within the OU4 Study Area (all HQs less than 1 as shown in Tables ES-9 and ES-10). Based on estimated pesticide concentrations in terrestrial plants and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to pesticides in Surface Soil within the OU4 Study Area (HQs less than 1 except for dieldrin in EU BB5 where the HQnoael was 19 as shown in Tables ES-9 and ES-10).

Metals and Cyanide

Aluminum, manganese, and cyanide were retained as refined COPECs in surface water based on comparison of detected concentrations to ESVs protective of aquatic life (Table ES-5), indicating a potential for adverse health effects. Eight metals (*i.e.*, cadmium, copper, lead, manganese, mercury, nickel silver, and zinc) and cyanide were retained as refined COPECs in Surface Sediment in one or more EUs based on comparison of detected concentrations to ESVs protective of benthic invertebrates (Table ES-5), indicating a potential for adverse health effects.

The bioaccumulative metals arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were detected in aquatic biota tissue samples (predatory fish and/or crayfish). Based on tissue residue evaluation for crayfish either HQnoael and HQloael or just HQnoael for arsenic, cadmium, chromium, lead, mercury, nickel, selenium, silver, and zinc were greater than 1 at one or more EUs (Table ES-6), indicating a potential for adverse health effects. Based on tissue residue evaluation for whole body predatory fish HQnoael and HQloael or just HQnoael for arsenic, cadmium, copper, lead, mercury, selenium, silver, and zinc are greater than 1 at one or more EUs (Table ES-6), indicating a potential for adverse health effects.

Twelve metals (*i.e.,* aluminum, barium, chromium, copper, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of terrestrial plants and invertebrates (Table ES-5), indicating a potential for adverse health effects. Eleven metals (*i.e.,* antimony, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium, vanadium, and zinc) and cyanide were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals(Table ES-5), indicating a potential for adverse health effects. The bioaccumulative metals arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were not analyzed in mouse tissue samples. However, based on estimated bioaccumulative metals concentrations in terrestrial plants and subsequent dietary exposure to higher trophic level organisms (*i.e.,* mourning dove and eastern gray squirrel), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to metals bioaccumulated in plants within the OU4 Study Area (HQs less than 1 with the exception of zinc at EU BB3 where the HQnoael was 2 as shown in Tables ES-9 and ES-10).

Conclusions

The primary Site-related contaminants are PCBs and chlorinated VOCs. The risk assessment confirmed that there is a potential for adverse human and ecological health effects from exposure to total PCB concentrations that is relatively wide-spread throughout the OU4 Study Area. The potential for non-cancer hazard from human exposure to total PCB Aroclors in sediment is limited to EU BB5, but total PCB Aroclors in floodplain soil, fish fillet, or shellfish was the predominant contributor to a non-cancer HI greater than 1 for at least one receptor population at every EU. When evaluated as TCDD TEQ, PCBs in fish fillet or shellfish was the predominant contributor to an unacceptable cancer risk or non-cancer hazard for at least one receptor population at every EU. The ERA indicated there is a potential for adverse health effects in ecological receptors from exposure to total PCBs in surface water, porewater, sediment, floodplain soil, and biota at every EU.

The BHHRA did not indicate a potential for adverse human health effects from exposure to chlorinated VOCs. However, the ERA concludes there is a potential for adverse health effects in ecological receptors from exposure to cis-1,2-DCE in porewater and sediment at EU BB5.

1 Introduction

This risk assessment presents an evaluation of the potential for adverse human and ecological health effects associated with exposure to chemicals detected in environmental samples from the Operable Unit 4 (OU4) Bound Brook Study Area (Study Area) at the Cornell-Dubilier Electronics (CDE) Superfund Site (Site) in Middlesex County, New Jersey [EPA ID: NJD981557879]. This report comprises the Baseline Human Health Risk Assessment (BHHRA) and Ecological Risk Assessment (ERA) for the OU4 Study Area.

The objectives of the risk assessment are to:

- Evaluate the potential for adverse human and ecological health effects, currently and in the future, in the absence of any major action to control or mitigate surface water, sediment, groundwater[9]/porewater, floodplain soil, and biota contamination (*i.e.*, baseline risks).
- Assist in determining the need for and extent of surface water, groundwater/porewater, sediment, and/or floodplain soil remediation.
- Provide a basis for comparing remedial alternatives and determining which will meet the goals of protection of human health and the environment and Applicable or Relevant and Appropriate Requirements, as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR Part 300.5).

The risk assessment is based on the analytical results (chemical and other testing data) of environmental samples collected during many different Site investigations, starting with sampling in 1997 for the U.S. Environmental Protection Agency's (USEPA) Ecological Evaluation (USEPA, 1999a) and extending through the 2010-2013 Remedial Investigation (RI) for the OU4 Study Area (hereinafter referred to as the OU4 RI), of which this risk assessment is a part. The risk assessment also incorporates OU4 RI data from two reference areas selected for the ERA.

[9] Groundwater data were not evaluated in this risk assessment. However, per the Record of Decision (ROD) for OU3 (Groundwater), groundwater discharge to Bound Brook is addressed by the OU4 RI. Sediment porewater samples were collected during the OU4 RI to evaluate the potential for groundwater discharge to Bound Brook, and the porewater data were evaluated in this risk assessment.

The OU4 RI was conducted in accordance with the USEPA-approved *OU4 Final Remedial Investigation/Feasibility Study Work Plan* (OU4 RI/FS Work Plan) [Louis Berger Group, Inc. and Malcolm Pirnie, Inc. (LBG/MP), 2010a], *OU4 Final Field Sampling Plan* (FSP) (LBG/MP, 2010b), *OU4 Final Quality Assurance Project Plan* (QAPP) (LBG/MP, 2010c), and the following field modifications:

- Field Modification No. 1 (April 2011): addresses consolidation of field programs and revision of laboratory-specific information for analysis of the high resolution sediment core and Ekman dredge sediment samples.

- Field Modification No. 2 (September 2011): addresses locations for the surface water sampling program to support the risk assessment and revision of laboratory-specific information.

- Field Modification No. 3 (October 2011): addresses USEPA-requested re-positioning of floodplain soil borings onto town or county-owned property. Due to this re-positioning, the floodplain soil boring program consisted of two field efforts (one in spring 2012 to collect the “gridded” borings and a subsequent effort in summer 2012 to collect the “transect” borings).

- Field Modification No. 4 (October 2011): addresses characterization in the expanded OU4 Study Area and revision of laboratory-specific information for analysis of sediment trap samples. In August 2011, the USEPA requested an expansion of the original OU4 Study Area to include (1) the riparian corridor of Bound Brook upstream of RM7.7 to RM8.3 (Talmadge Road Bridge), and (2) the riparian corridor and floodplain soils on Green Brook from RM0 to RM-1.6 (Shepherd Avenue Bridge). Due to this expansion, the field program consisted of two field efforts (one in the Summer 2012 and a subsequent effort in Fall 2012 to characterize the expanded area). However, when discussing the OU4 Study Area and the RI data, no differentiation between the original Study Area and the “expanded” area is provided.

- Field Modification No. 5 (June 2012): addresses characterization of the reference area and laboratory-specific information on toxicity and bioaccumulation testing to support the risk assessment.

- Field Modification No. 6 (June 2012): addresses rationale and analytical methods for in-situ porewater sampling.
- Field Modification No. 7 (April 2012): addresses modeling data needs.
- Field Modification No. 8 (June 2012): addresses repositioning of the deep soil borings.
- Field Modification No. 9 (May 2013): addresses characterization of Veterans Memorial Park and surrounding open "green" space on the floodplain to evaluate nature and extent of contamination on the floodplain and to support the risk assessment.

Of the field modifications, No. 7 and No. 8 pertain to data collection activities not applicable to the risk assessment. The OU4 RI field investigation was initiated in October 2010 and completed in May 2013.

Consistent with the OU4 RI Report, the following terminology is used throughout this risk assessment:

- The "Site" refers to all four OUs which comprise the CDE Superfund Site, and the extent of each OU investigation.
- The "former CDE facility" refers to the physical extent of the industrial park operated at 333 Hamilton Boulevard, South Plainfield, New Jersey.
- "OU4" refers to the geographic extent of the Bound Brook and Green Brook contamination and associated investigation; this area is also referred to as the "OU4 Study Area" or simply "Study Area." The extent of the OU4 Study Area is shown on Figures 1-1 and 1-2.

The BHHRA follows the USEPA's *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual Part A* (RAGS) (USEPA, 1989) and other USEPA guidance. The BHHRA is presented in a series of tables that follow the USEPA's RAGS Part D (USEPA, 2001b) format. These tables are provided in Appendix A. The ERA consists of a screening-level evaluation and baseline ERA, and as such, incorporates components of Steps 1 through 8 of the USEPA's *Ecological Risk Assessment Guidance for Superfund* (ERAGS) (USEPA, 1997 and updates) and other applicable guidance.

This document is organized as follows:

- Section 1, Introduction – describes the location of the Site and OU4 Study Area; contains Site background information; and provides brief summaries of prior investigations of the Site and OU4 in particular.
- Section 2, Risk Assessment Data Sets – presents the exposure units (EU) established for this risk assessment; describes the data sets (*e.g.*, surface water, sediment, floodplain soil, fish tissue, *etc.*) used in the assessment of the potential for adverse human and ecological health effects; and provides a brief discussion of data comparability and usability.
- Section 3, Conceptual Site Exposure Models – presents the current understanding of sources of chemical contamination originating from the former CDE facility; discusses chemical mobility and migration pathways through the OU4 Study Area; identifies potentially exposed human populations and ecological communities and populations (termed human and ecological receptors); and illustrates pathways through which human and ecological exposure may occur.
- Section 4, BHHRA – presents aspects specific to the human health risk assessment, including the selection of chemicals of potential concern (COPC); equations and parameter values used to model potential human exposures; toxicity values used to evaluate the potential for adverse health effects; and quantitative estimates of incremental lifetime cancer risk and non-cancer hazard.
- Section 5, ERA – presents aspects specific to the ecological risk assessment, including definition of assessment and measurement endpoints; a screening-level evaluation and refinement step for the selection of chemicals of potential ecological concern (COPEC); the methodology used to model exposure for the measurement endpoints; measures of effects; and the ecological risk characterization.
- Section 6, Uncertainty Evaluation – documents potential sources of uncertainty in the risk assessment process and evaluates whether the potential for adverse human and ecological health effects may be over- or under-estimated.

- Section 7, Conclusions – presents the pertinent findings and conclusions regarding the potential for adverse human and ecological health effects.
- Section 8, References.

The remainder of Section 1 provides an overview of the OU4 Study Area location and background on the former CDE facility, as well as brief summaries of prior environmental investigations of the Site and OU4 in particular.

1.1 Study Area Location

Bound Brook, located in Middlesex County, New Jersey, is classified as FW-2 NT (freshwater, non-trout) and is a secondary tributary of the Raritan River that flows into Raritan Bay (south of Staten Island, New York) and the Greater New York/New Jersey Harbor (Figure 1-1). The headwaters of Bound Brook originate in areas of residential and commercial/industrial development in Edison Township, just upstream of Dismal Swamp Conservation Area. Bound Brook flows westerly through South Plainfield, New Jersey into Piscataway Township, where the water is dammed to form New Market Pond. The brook then flows through Middlesex Borough to the confluence with Green Brook. As shown on Figure 1-2, the Study Area encompasses an 8.3-mile long portion of Bound Brook, plus an additional 1.6-mile long portion of Green Brook, portions of Cedar Brook (the largest tributary to Bound Brook), Spring Lake (an impoundment on Cedar Brook), and two other unnamed tributaries to Bound Brook.

A River Mile (RM) system was developed for the OU4 RI, with RM0 placed at the confluence of Bound Brook and Green Brook. This system was used to position the OU4 RI sampling locations, reference historical sampling locations, and describe the location of prominent site features. As determined by the USEPA, the upstream extent of the investigation area is at RM8.3 at the Talmadge Road Bridge on Bound Brook in Edison, New Jersey, and the downstream extent is at RM-1.6 at the Shepherd Avenue Bridge on Green Brook in Bridgewater, New Jersey. The Green Brook portion of the OU4 Study Area was added after they RM numbering scheme had been established, hence the negative RM notation. The northern extent of the Study Area on Cedar Brook is Cedar Brook Avenue in South Plainfield, New Jersey.

The Study Area includes:

- Surface water and sediments in the main waterway channel from RM-1.6 to RM8.3, plus the three major tributaries[10] to Bound Brook: the unnamed tributary near New Brunswick Avenue (confluence at RM4.7), unnamed tributary near Elsie Avenue (confluence at RM5.5), and Cedar Brook. Minor tributaries, ditches, and culverts are within the OU4 Study Area but were not investigated under the RI.

- Floodplain soils (proximally within the 100-year floodplain) from RM-1.6 to RM7.4 located mainly on public lands adjacent to the brook and accessible for sampling. Floodplain soils, tributaries, and wetlands upstream of RM7.4 are being investigated under the Woodbrook Road Dump Superfund Site (Woodbrook Site).

1.2 Background on the Former CDE Facility

The property known as the former CDE manufacturing facility (former CDE facility) is located between RM6.1 and RM6.6 on Bound Brook (Figure 1-2). This fenced, 26-acre property is bounded on the northeast by Bound Brook and the former Lehigh Valley Railroad, Perth Amboy Branch (presently Conrail); on the southeast by Bound Brook and a property used by the South Plainfield Department of Public Works; on the southwest, across Spicer Avenue, by single family residential properties; and to the northwest, across Hamilton Boulevard, by mixed residential and commercial properties (Figure 1-3).

The Spicer Manufacturing Company operated a manufacturing plant on the property from 1912 to 1929. They manufactured universal joints and drive shafts, clutches, drop forgings, sheet metal stampings, screw products, and coil springs for the automobile industry. The plant included a machine shop, box shop, lumber shop, scrap shop, heat treating building, transformer platform, forge shop, shear shed, boiler room, acid pickle building, and die sinking shop. A chemical laboratory for the analysis of steel was added in 1917. Most of the major structures were erected by 1918. When the Spicer Manufacturing Company ceased operations at the facility, the property consisted of approximately 210,000 square feet of buildings [Foster Wheeler Environmental

[10] The three major tributaries were sampled during the OU4 RI to investigate potential off-site sources of contamination to Bound Brook. With the exception of data from one low-resolution core from Cedar Brook, which was collected between Bound Brook and Spring Lake and included in the Spring Lake sediment data set, data from these tributaries were not included in the risk assessment.

Corporation (Foster Wheeler), 2002]. Even though trichloroethene (TCE), a documented groundwater contaminant at the former CDE facility, was commercially available during the latter half of Spicer Manufacturing Company's period of operation at the former CDE facility, there is no documentation that TCE was used in the manufacturing process during their period of operation at the property.

After the departure of the Spicer Manufacturing Company, CDE manufactured electronic components, including polychlorinated biphenyl (PCB)-containing capacitors, from 1936 to 1962, according to information provided by CDE in November 1996 in response to EPA' s request for information. PCB and chlorinated organic degreasing solvents were used in the manufacturing process, and the company disposed of PCB-containing materials and other hazardous substances at the facility. It has been reported that the rear of the property was saturated with transformer oils and capacitors were also buried behind the facility (Foster Wheeler, 2002). The primary site-related chemicals of concern are PCB compounds and chlorinated volatile organic compounds (VOC). The company released PCB contaminated material and TCE directly onto the soils during its operations. In its November 1996 response to EPA' s request for information, CDE provided information that Aroclor 1254 was used in its power factor capacitors and some other capacitors. Based on deposition testimony, CDE was also using Aroclor 1242 in the early 1960s in power factor capacitors. It has been reported that the company also tested transformer oils for an unknown period of time.

CDE's use of PCBs is documented in multiple catalogs and marketing material from 1937-1945. For example, a 1939 CDE catalogue shows a number of PCB-containing capacitors, sold under the trade name Dykanol (CDE, 1939), and CDE advertisements in the Proceedings of the Institute of Radio Engineers from 1937 to 1944 refer to and describes Dykanol impregnated capacitors. CDE mentions "chlorinated diphenol" as one of the materials used at their facility in a 1941 annual report (CDE, 1941). Information on net sales and income reported by CDE to Moody's Manual of Investments between 1949 and 1962 suggests that capacitor production first peaked in 1943, declined, and then rose again in the 1950s.

After CDE departed from the facility in 1962, it was operated as a rental property for commercial and light industrial tenants. Numerous tenants occupied the complex.

In 2006, the USEPA began implementing the OU2 Record of Decision (ROD) with relocation of the tenants at the industrial park, followed by demolition of the former CDE facility structures, which was completed in 2008, and excavation of the capacitor disposal area. In 2009, soil remediation commenced, which included: excavating, treating and/or disposing of contaminated soil from the former CDE facility; installing a multi-layered cap; and constructing a storm water conveyance system and detention basin. Restoration and paving activities were completed in April 2012.

Prior to the OU2 remedial activities, the developed portion of the facility (the northwestern portion) comprised approximately 45 percent of the total land area, which included a system of catch basins to channel stormwater flow, and paved roadways. Several of the catch basins drained into a stormwater collection system with outfalls that discharged at various locations along Bound Brook. The other 55 percent of the property was predominantly vegetated. The central part of the undeveloped portion was primarily an open field, with some wooded areas to the northeast and south, and a deteriorated, partially paved area in the middle of the undeveloped portion of the facility. The northeast and southeast boundaries consist primarily of wetland areas adjacent to Bound Brook. As part of OU2 remedial activities, the majority of the developed portion of the former CDE facility was capped with asphalt pavement following building demolition and soil excavation. With completion of OU2 remedial activities, almost the entire former CDE facility is covered by an asphalt cap with a storm water collection system and detention basin.

1.3 Previous Environmental Investigations

This section provides a brief description of previous environmental investigations at the Site and OU4 in particular. More detailed summaries of the major studies and remedial work that were previously conducted at the Site, as well as background on former and active industrial sites located upstream of the OU4 Study Area, are included in the OU4 RI Report, Section 2.

Environmental conditions at the former CDE facility were first investigated by the New Jersey Department of Environmental Protection (NJDEP) in 1986. Subsequent sampling by the NJDEP and USEPA showed the presence of PCBs, VOCs, and inorganic chemicals in facility soils, sediments, and surface water. In 1997, the USEPA conducted a preliminary investigation of Bound Brook and also collected surface soil and interior dust samples from nearby residential and commercial properties. These investigations led to fish consumption advisories for Bound Brook and its tributaries. As a result of these sampling activities, the Site was added to the National Priorities List (NPL) in July 1998.

Between 1997 and 2000, the USEPA ordered several removal actions to be performed, including:

- Removing PCBs in interior dust and soils at residential properties located west and southwest of the former CDE facility.
- Paving driveways and parking areas, installing a security fence, and implementing drainage controls at the former CDE facility.

In 2000, an RI was conducted by Foster Wheeler that included the collection of soil, sediment, and building surface samples, as well as the installation and sampling of 12 shallow bedrock monitoring wells (Foster Wheeler, 2002). The results documented concentrations of VOCs, PCB Aroclors, pesticides, and inorganics in bedrock groundwater. Shortly thereafter, the USEPA divided the Site into four OUs, as follows, to facilitate investigation and remediation:

- OU1 addresses residential, commercial, and municipal properties in the vicinity of the former CDE facility. The USEPA signed a ROD for OU1 in 2003.
- OU2 addresses contaminated soils and buildings at the former CDE facility. The USEPA signed a ROD for OU2 in 2004.
- OU3 addresses contaminated groundwater. USEPA issued a ROD for OU3 in 2012. It should be noted that the OU3 ROD specifies that groundwater discharge to Bound Brook is to be addressed by the OU4 RI.
- OU4 addresses Bound Brook. This risk assessment was conducted as part of the RI/FS for OU4.

Beginning with the preliminary investigation of Bound Brook in 1997, the USEPA conducted several initial studies to investigate the nature and extent of contamination in Bound Brook sediments and floodplain soils as well as to assess the potential risks associated with this contamination. These investigations are summarized in chronological order, in the following sections. The historical data sets were compiled in a database included as Appendix L to the OU4 RI Report.

Historical sediment, floodplain soil, biota, and toxicity testing data were combined with OU4 RI data to form the data sets used in this risk assessment. As they are no longer considered representative of Bound Brook, historical surface water data are discussed but excluded from evaluation of the potential for adverse human and ecological health effects.

1.3.1 1997 Ecological Evaluation

In June and August 1997, USEPA collected soil, sediment, surface water, and biota samples (small mammals, crayfish, forage fish, and edible fish)along Bound Brook to support an ecological risk assessment. Sampling locations were designed to characterize exposure in terrestrial and aquatic areas near Bound Brook, New Market Pond, Cedar Brook, and Spring Lake. Sampling locations stretched from RM2 to RM6.6 on Bound Brook, with a few samples in Green Brook. Samples were analyzed for Target Compound List (TCL) VOCs, base-neutral acid extractable compounds (BNA), TCL pesticides, PCB Aroclors, and Target Analyte List (TAL) metals.

Sediment toxicity tests were also performed using sediment samples from four locations in Bound Brook and two locations in New Market Pond. Sediment from a former reference area that is now located within the Study Area was also used in the toxicity tests. Survival and growth results from the 14-day toxicity test on amphipods (*H. azteca*) indicated growth was not reduced at any location; however, survival in sediment from one location in Bound Brook (at approximately RM5.15) was statistically significantly lower than the reference location (approximately at RM6.98).

Results of the USEPA's 1997 Ecological Evaluation are presented in the *Final Report: Ecological Evaluation for the Cornell-Dubilier Electronics Site* (USEPA, 1999a). The report concluded that the structure and function of the stream ecosystem within Bound Brook and its corridor was at risk from chemical contamination.

1.3.2 1997 Sediment and Soil Sampling

From August to November 1997, USEPA collected additional sediment and soil samples along Bound Brook. Surface and subsurface sediment and soil samples were collected to characterize 2.4 miles of streambed and bank areas upstream and downstream of the former CDE facility (from RM4.2 to RM6.6). The sampling program included 100 transects across Bound Brook, spaced at varying intervals of 50 feet, 100 feet, and 200 feet distant from each other. Along each transect, five sampling locations were established: one sediment sampling location positioned in the middle of the stream and two soil sampling locations on each side of the brook (5 feet and 10 feet upland from the water's edge). At each sampling location, two discrete depth intervals were sampled to characterize the surface (0-6 inches) and subsurface material (generally between 6-24 inches). Samples were analyzed for PCB Aroclors only; these data are presented in the *Soil and Sediment Sampling and Analysis Summary Report* (USEPA, 1998b).

1.3.3 1999 Cedar Brook and Spring Lake Sediment Sampling

In April 1999, the NJDEP collected sediment samples from 33 locations in Spring Lake, Cedar Brook, and a feeder stream between Maple Avenue and Cedar Brook. Sediment samples were collected at a depth of 0-6 inches at all locations. Five subsurface samples were also collected from 18-24 inches below the sediment surface. The samples were analyzed for pesticides and PCB Aroclors. These data are presented in *Preliminary Assessment and Site Investigation, Spring Lake PCB Contamination* (NJDEP, 1999).

1.3.4 1999 Floodplain Soil and Sediment Sampling

In June 1999, USEPA collected 92 floodplain soil and 6 sediment samples from four areas along Bound Brook and its tributaries. These sampling areas were designated as Area 1 "Veterans Memorial Park" (floodplain soil samples), Area 2 "North Side of Cedar Brook" (between Lowden and Oakmoor Avenues; floodplain soil and sediment samples), Area 3 "North Side of Bound Brook" (near Fred Allen Drive; floodplain soil samples), and Area 4 "South of New Market Avenue and East of Highland Avenue" (floodplain soil and sediment samples). Samples were analyzed for PCB Aroclors only; these data are presented in the *Floodplain Soil/Sediment Sampling and Analysis Summary Report* (Weston Solutions, 2000).

At the request of USEPA, floodplain surface soil data were evaluated by the New Jersey Department of Health and Senior Services and the Agency for Toxic Substances and Disease Registry (NJDHSS, 2000). They concluded that a complete exposure pathway, through ingestion of contaminated soils, can be reasonably assumed for those individuals who are utilizing and recreating in the Bound Brook floodplain area. However, no public health hazard was identified for either adult or child recreational exposures at the maximum PCB concentration reported (NJDHSS, 2000).

1.3.5 2002 Veterans Memorial Park Investigations

In March and August 2002, the Borough of South Plainfield conducted a Site Investigation (SI) of Veterans Memorial Park, which is located on public property between Cedar Brook and Bound Brook. Originally, this land and adjacent property consisted of low-lying wetland areas, which were reportedly filled to raise grade and allow for municipal use.

Soil samples were collected from areas of stressed vegetation, from soil borings and test pits to characterize historic fill, and on the east side of the park adjacent to residential properties that border the park. The soil samples adjacent to residential properties along Kaine Avenue were collected in response to concerns regarding the USEPA 1999 floodplain soil sample results and were analyzed for PCB Aroclors only. Additional samples were collected to investigate asbestos-containing tiles and materials observed along the embankment of a dry pond area and to identify a “tar-like” substance seeping from the ground surface (AOC 5). Two sediment samples were also collected from the surface of the dry pond. Analytical data are presented in *Site Investigation Report/Interim Remedial Action Work Plan - Veterans Memorial Park* (PMK Group, 2002) and *Interim Remedial Action Report - Veterans Memorial Park* (PMK Group, 2004).

As a result of these investigations, the following approximate volumes of soil and/or materials were excavated and removed from the park:

- 120 cubic yards of PCB-contaminated soil from the east side of the park,
- 16,750 square feet (and 3 to 5 feet bgs) of material associated with the tar-like substance, along with multiple drums,

- 6,000 square feet (and 4 to 6 feet bgs) of exposed asbestos-containing tiles and materials on the pond embankment, and
- 1,500 cubic yards of soil from the baseball field, to address elevated PCB and arsenic concentrations.

Interim remedial action at the park began in September 2003 and ended in December 2003.

1.3.6 2007-08 Soil, Sediment, and Surface Water Sampling

In April 2007, erosion exposed buried capacitor debris on the banks of Bound Brook, near the twin culverts (*i.e.,* the location where Bound Brook passes beneath a former railroad spur that served the former CDE facility) and adjacent to the former CDE facility. As a result, the USEPA's Emergency Response Team (ERT) conducted soil, sediment, and surface water sampling. Forty-four transects (Transects A through RR) from the 1997 sampling event were re-sampled to re-characterize a half-mile of Bound Brook between RM6.10 and RM6.67. Soil and sediment samples were re-collected from five locations along each transect, as described in Section 1.3.2. One surface water sample was collected at the approximate center of each transect. Soil and sediment samples were analyzed for PCB Aroclors only; these data are presented in the USEPA Sampling Report (USEPA, 2008d).

1.3.7 2008 Test Pit Investigation

A test pit investigation conducted by USEPA contractors in May 2008 documented the presence of capacitors, micro-capacitors, and plastic film among debris located in the sloping banks of Bound Brook adjacent to OU2 and areas proximal to the former CDE facility. Buried debris was observed in four of the eight test pits that were located on the east and southeast sides of the former CDE property.

Originally, delineation of the vertical extent of buried waste was planned for the OU4 RI. However, these test pit areas were excavated in 2010 as part of the OU2 remedial action. The limits of the OU2 remedial area were established with the understanding that a transition area between the edge of OU2 and Bound Brook was likely to contain additional debris that would be addressed by an OU4 remedy. Consequently, deep soil borings installed during the OU4 RI were repositioned immediately east of the OU2 excavation areas in the vicinity of the former test pits.

In June 2012, deep soil borings were advanced to depths between approximately 8 and 10 feet bgs before groundwater or weathered bedrock was encountered. Soil samples were collected from 30-cm intervals; a total of 26 samples were obtained in the debris areas, of which 22 samples were analyzed for PCB Aroclors, TCL SVOCs, TAL metals, cyanide, and total organic carbon (TOC). However, analytical data from these deep soil borings were not included in this risk assessment, as the purpose of the investigation was to determine the depth extent of capacitor waste previously observed in test pits excavated by USEPA contractors in 2008.

1.3.8 2007/2009 Woodbrook Road Dump Superfund Site

Samples of Bound Brook surface water and sediment that were collected as part of the RI/FS for the Woodbrook Site, located approximately one mile upstream of the former CDE facility and downstream of Dismal Swamp, were considered for inclusion in this risk assessment. The surface water data are summarized and discussed in this report but were not included in the evaluation of the potential for adverse human and ecological health effects. Sediment data were, however, incorporated into the risk assessment data sets.

In April and May 2007, Bound Brook surface water and sediment samples were collected to investigate the Woodbrook Site. Samples were collected from locations on Bound Brook adjacent to the dump site (BS-1 through BS-12), downstream of the dump site (BD-1 through BD-6), and upstream of the dump site (BU-1 through BU-10). Surface water and sediment samples were analyzed for TCL VOCs/Semi-volatile organic compounds (SVOC)/pesticides, PCB Aroclors, and TAL metals (total and dissolved). These data are presented in *Draft Site Characterization Summary Report* (TRC Environmental Corporation, 2007).

In August 2009, sediment samples were re-collected from select locations, including BU-10 in Bound Brook. The sediment samples were analyzed for PCB Aroclors, PCB congeners, and dioxins/furans. These data are presented in the *Addendum to Draft Site Characterization Summary Report* (TRC Environmental Corporation, 2009).

1.3.9 2008/2009 USEPA Reassessment

In September and October 2008, USEPA collected biota (fish and Asiatic clam) samples from seven stations to re-evaluate ecological risks and to provide a fingerprint of the PCB congeners within Bound Brook extending from the former CDE facility to New Market Pond. Sampling locations mirrored those used for USEPA's 1997 Ecological Evaluation, with the exception of adjustments to those closest to the former CDE facility, and included six locations in Bound Brook and one in Spring Lake. Fish species targeted for collection were based on the data generated during the USEPA sampling in 1997. All biota samples were analyzed for PCB Aroclors and PCB congeners. In addition, twelve sediment samples were collected at two of the Bound Brook stations sampled for biota and were analyzed for PCB congeners.

In December 2008, a wildlife species investigation was conducted on Bound Brook, from Dismal Swamp to approximately RM5.3, approximately 0.5 miles downstream of the confluence of Bound Brook and Cedar Brook. The investigation consisted of a reconnaissance-level habitat assessment and wildlife species search to evaluate potential species occurrence in the Bound Brook corridor. The findings of the investigation are provided in the *Wildlife Species Investigation of the Bound Brook Ecosystem, South Plainfield, New Jersey* (Stantec, 2008). This investigation conclusively determined that several wildlife species utilize Bound Brook within the Site boundary.

The 2008/2009 Reassessment supported USEPA's previous conclusion in 1997 that a substantive ecological risk does exist to fish and wildlife within both Bound Brook and Spring Lake (USEPA, 2010a).

2 Risk Assessment Data Sets

This section presents the approach that was used to organize the large number of samples collected to investigate OU4, the chemical and other testing data available for each environmental medium sampled (*e.g.*, surface water, sediment, *etc.*), and the data sets used to evaluate the potential for adverse human and ecological health effects. A brief discussion of data comparability and usability is also presented, as this risk assessment is based on analytical data from many different Site investigations.

The selection of COPCs and COPECs are presented in, respectively, the BHHRA (Section 4) and ERA (Section 5).

2.1 Exposure Units

Due to the large number of available sediment and floodplain soil samples, and because the nature and extent of chemical contamination throughout the approximately ten mile long Study Area is not homogeneous, multiple EUs were established for this risk assessment. EUs were based on physical features of the Site and Bound Brook system (*i.e.,* upstream/downstream of the former CDE facility, flowing/impounded water) and historic PCB concentrations, with boundaries adjusted to key landmarks (*e.g.,* Clinton Avenue bridge). The potential for adverse human and ecological health effects was evaluated for each EU, to facilitate decisions regarding potential remedial actions.

Figure 2-1 shows the location of each of the following EUs:

- Green Brook (GB) – applies to the 1.6-mile long portion of the Green Brook channel and its 100-year floodplain, from the Shepherd Avenue bridge over Green Brook at RM-1.6, upstream to the confluence with Bound Brook at RM0.
- Bound Brook 1 (BB1) – applies to the Bound Brook channel and its 100-year floodplain, from the confluence with Green Brook at RM0, upstream to the spillway of New Market Pond at RM3.43.
- Bound Brook 2 (BB2) – applies to New Market Pond and its 100-year floodplain, from Bound Brook RM3.43, upstream to the eastern end of New Market Pond at RM4.09.

- Bound Brook 3 (BB3) – applies to the Bound Brook channel and its 100-year floodplain, from the eastern end of New Market Pond at RM4.09, upstream to the Clinton Avenue bridge at RM5.22.
- Bound Brook 4 (BB4) – applies to the Bound Brook channel and its 100-year floodplain, from the Clinton Avenue bridge at RM5.22, upstream to the Lakeview Avenue bridge at RM6.18 and approximately 500 feet of the Cedar Brook channel and its 100-year floodplain upstream to Veterans Memorial Park/near the spillway bridge to Spring Lake.
- Bound Brook 5 (BB5) – applies to the Bound Brook channel and its 100-year floodplain, from the Lakeview Avenue bridge at RM6.18, upstream to the Belmont Avenue bridge at RM6.82. The former CDE facility is adjacent to BB5.
- Bound Brook 6 (BB6) – applies to the Bound Brook channel, from the Belmont Avenue bridge at RM6.82, upstream to the Talmadge Road bridge at RM8.3. From RM6.82 upstream to RM7.4, the Study Area includes the 100-year floodplain. From RM7.4 upstream to RM8.3, the Study Area includes only the channel (surface water and sediment).
- Spring Lake (SL) – applies to Cedar Brook, from north of Veterans Memorial Park/near the spillway bridge to Spring Lake, Spring Lake, and upstream on Cedar Brook to Cedar Brook Avenue.

Two reference areas were identified for use in the ERA. The selected reference areas are Ambrose Brook and Lake Nelson, an impoundment on Ambrose Brook. These reference areas are not within the Study Area boundary and were therefore not included as separate EUs within OU4. Reference area surface sediment and floodplain soil samples were collected during the OU4 RI for chemical analysis, sediment toxicity testing, and sediment and floodplain soil bioaccumulation testing. Analytical results were used to evaluate existing conditions within the Study Area. Ambrose Brook was selected as the reference area for stream channel sediment and floodplain soil within the Study Area, and Lake Nelson was selected as the reference area for New Market Pond and Spring Lake. The memorandum recommending these reference areas is included in Appendix B.

2.2 Risk Assessment Data Sets

Available analytical data and the chemical and testing data sets used in the BHHRA and ERA are described by environmental medium, below. Data from both the Study Area and reference areas are discussed, as applicable to each sampled medium.

2.2.1 Surface Water

OU4 surface water data are available from the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), the USEPA ERT sampling conducted in 2007-08, the RI[11] of the Woodbrook Site (TRC Environmental Corporation, 2007), and the OU4 RI samples collected in September 2011 and July-August 2012. However, the only surface water data used to evaluate the potential for adverse human and ecological health effects are from the OU4 RI samples. These data represent the most recent samples and span the entire Study Area. Older surface water data are discussed in the BHHRA and ERA but were not included in the risk assessment data set.

Table 2-1 lists the 32 samples included in this risk assessment. The twelve samples with IDs starting "CDEOU4" are whole water grab samples. Unfiltered samples were analyzed for TCL VOCs/SVOCs, TCL pesticides/PCB Aroclors, and cyanide. Filtered and unfiltered samples were analyzed for TAL metals. Only unfiltered surface water data were evaluated in the HHRA, while both filtered and unfiltered surface water data were evaluated in the ERA. Twenty surface water samples (SW01 through SW20) were collected as part of the porewater sampling program (refer to Section 2.2.2) and were analyzed for PCB congeners only. These samples were collected using passive sampling devices and are time-integrated samples that represent equilibrium conditions.

The surface water data set includes samples collected at locations in Bound Brook between the confluence with Green Brook to just downstream of the Woodbrook Site, as well as from Green Brook itself, downstream of the confluence with Bound Brook. The

[11] As indicated in Section 1.3.8, of the analytical data available from the RI of the Woodbrook Road Dump Superfund Site, only surface water and sediment data from sample locations on Bound Brook were considered for inclusion in this risk assessment. Surface water and sediment data from other watercourses sampled as part of the Woodbrook Road RI were not considered for inclusion, as they are not within the OU4 boundary.

most upstream surface water samples, collected at the Talmadge Road bridge, were used as background or reference samples. Water samples were also collected during the OU4 RI from groundwater seeps observed at three locations along Bound Brook, from Green Brook upstream of the confluence with Bound Brook, and from the three major tributaries to Bound Brook, but these samples were not included in the risk assessment. The locations of all surface water and seep samples collected during the OU4 RI are shown on Figure 2-2.

As there are a limited number of samples from the OU4 RI and these data represent a dynamic system, surface water data were evaluated system-wide and were not separated into data sets by EU. It was assumed the risks/hazards estimated for the surface water pathway can be added to those estimated by EU for the other exposure pathways, to arrive at total risks/hazards for each EU.

2.2.2 Porewater

Porewater samples were collected during the OU4 RI to investigate the potential for shallow groundwater discharge to Bound Brook sediments and surface water and, if possible, to determine potential discharge points. Porewater samples were collected using passive sampling devices deployed in Bound Brook sediments adjacent to, upstream of, and downstream from the former CDE facility. The furthest downstream location was at RM5.8, and with the exception of the background sample location at RM8.29, the furthest upstream location was at RM6.63. Sampling locations are listed in Table 2-2 and shown on Figure 2-2.

VOC passive diffusion bags were deployed for two sampling events (the same locations were occupied for each event), with the first deployment spanning 12-13 days and the second over 27-31 days. Data are available from 34 VOC samples, including two upstream samples. PCB polyethylene passive samplers were deployed for 33-37 days and at two to six depths per sample location. Data are available from 40 PCB congener samples, including two upstream samples.

2.2.3 Sediment

Available sediment data are from samples collected for chemical analyses, toxicity testing, and bioaccumulation testing. The available data and data sets established for this risk assessment are discussed by data type, below.

2.2.3.1 Sediment Data Sets

OU4 sediment data are available from the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), USEPA's 1997 sediment and soil sampling (USEPA, 1998), NJDEP's investigation of Spring Lake (NJDEP, 1999), USEPA's 1999 floodplain soil and sediment sampling (Weston Solutions, 2000), the USEPA ERT sampling conducted in 2007-08 (USEPA, 2008d), the RI[12] of the Woodbrook Site (TRC Environmental Corporation, 2007 and 2009), and the OU4 RI. Of the sediment data available from the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), two samples collected from Green Brook, at location A14, were not included in the risk assessment data sets, as these samples were collected downstream of the Study Area boundary.

Sediment data used in the quantitative assessment of the potential for human health and ecological risks were separated into two data sets based on sample depth: Surface Sediment and All Sediment. Surface Sediment samples were considered any sediment sample collected from a depth starting at 0 centimeters [cm] (*e.g.*, 0 to 15.24 cm, 0 to 28 cm). The Surface Sediment data set also included two low resolution core samples collected at depths of 3-16 cm and 10-14 cm below the sediment-water interface. Only the Surface Sediment data set (representing sediment inclusive of the top 15 cm) was used in the ERA. The All Sediment data set comprises all sediment samples, regardless of depth. Table 2-3 shows the number of Surface Sediment and All Sediment samples included in each EU and from each investigation. Table 2-3 also indicates the analyses performed on each set of samples, but does not include sediment samples collected for toxicity and bioaccumulation testing, as these samples were not used in the quantitative

[12] As indicated in Section 1.3.8, of the analytical data available from the RI of the Woodbrook Road Dump Superfund Site, only surface water and sediment data from sample locations on Bound Brook were considered for inclusion in this risk assessment. Surface water and sediment data from other watercourses sampled as part of the Woodbrook Road RI were not considered for inclusion, as they are not within the OU4 boundary.

risk assessment. Figure 2-3 shows the EU boundaries with the locations of historic and OU4 RI sediment samples included in this risk assessment.

During the OU4 RI, to provide characterization of sediment in the reference areas, a total of ten surface sediment samples (*i.e.*, seven in Ambrose Brook and three in Lake Nelson) were collected and analyzed for PCB Aroclors or PCB congeners, pesticides, SVOCs, VOCs, and metals as well as TOC, grain size, and acid volatile sulfide-simultaneously extracted metals (AVS-SEM); select samples were also analyzed for dioxins/furans. These sediment samples are also listed in Table 2-3. The reference area sampling locations are shown on Figure 2-4.

Lastly, surface sediment data are available from a pond at Veterans Memorial Park. Data are from the Borough of South Plainfield's SI conducted in 2002 and from OU4 RI samples collected in May 2013. These data are summarized and compared to screening toxicity values but are not listed in Table 2-3 and were not used in a quantitative assessment of the potential for human or ecological health risks.

2.2.3.2 Sediment Toxicity Testing

Sediment toxicity tests were conducted as 14-day tests on amphipods (*H. azteca*) as part of the USEPA's 1997 Ecological Evaluation (USEPA, 1999a). Study Area sediment from the following locations was used in the toxicity tests:

- Study Area – four locations in Bound Brook (at approximately RM4.62, RM5.15, RM5.60, RM6.45) and two locations in New Market Pond (at approximately RM3.48 and RM4.12).
- Reference Area – one location in Bound Brook (at approximately RM6.98, which is now located within the Study Area and therefore can no longer be considered a reference area).

Laboratory control sediment was also used. Measured effects included mortality (percent mortality) and growth (total length).

Acute and chronic toxicity tests on one amphipod species and one species of midge (*i.e.*, *H. azteca* and *C. dilutus*) were conducted as part of the OU4 RI. Testing was performed in accordance with the USEPA document *Methods for Measuring the Toxicity and*

Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates (EPA 600/R-99/064). Laboratory-reared test organisms were used. The acute and chronic tests on *H. azteca* were 10-day and 42-day tests, respectively. The acute and chronic tests on *Chironomus tentans* were 10-day and 50- to 65-day tests, respectively.

In addition to laboratory control sediment, sediment collected from the following locations was used in the toxicity tests:

- To evaluate Bound Brook sediments – three locations in Bound Brook (at RM3.01, RM4.85, and RM6.51) and one reference sediment location in Ambrose Brook.
- To evaluate New Market Pond sediments – two locations on the west and east ends of New Market Pond (approximately at RM3.48 and RM4.12) and one reference location on the west end of Lake Nelson.

The sampling locations for sediment toxicity tests within Bound Brook and New Market Pond were selected to satisfy the OU4 RI/FS Work Plan requirements (outlined in Field Modification No. 5) as follows:

- Location at RM6.51 – adjacent to the former CDE facility and to verify previous toxicity testing results.
- Location at RM4.85 – located between the former CDE facility and New Market Pond (between RM4.1 and RM6.0) and to address data gaps in the USEPA's 1997 Ecological Evaluation.
- Location at RM3.01 – located downstream of New Market Pond (between RM0 and RM3.4) and to address data gaps in the USEPA's 1997 Ecological Evaluation.
- Location at RM3.48 – located in New Market Pond and to verify previous toxicity testing results.
- Location at RM4.12 – added at the request of the USEPA and to verify previous toxicity testing results.

The reference location within Ambrose Brook was selected based on similar stream conditions (*e.g.,* stream width, depth, and substrate) as the locations in Bound Brook. The reference location from Lake Nelson was selected based on similar conditions (*e.g.,* water depth and substrate) as the sample locations within New Market Pond. Accessibility to the reference area locations was also taken into consideration when selecting final sampling locations within the reference areas.

Measured effects from short-term toxicity tests include acute effects (*e.g.*, survival and growth). Measured effects from long-term toxicity tests include chronic effects (*e.g.*, survival, growth, and reproduction) which includes sub-lethal effects (*e.g.*, growth and reproduction). Sediment samples collected for toxicity tests were also analyzed for PCB congeners or PCB Aroclors, pesticides, SVOCs, VOCs, and metals as well as TOC, grain size, and AVS-SEM. However, these samples are not listed in Table 2-3 as they were not used in a quantitative assessment of the potential for human health or ecological risks.

The sediment collection locations for toxicity testing within Bound Brook from both the USEPA's 1997 Ecological Evaluation and the OU4 RI are shown on Figure 2-5. The sediment collection locations for toxicity testing within Ambrose Brook and Lake Nelson from the OU4 RI are shown on Figure 2-4.

2.2.3.3 Sediment Bioaccumulation Testing

Sediment bioaccumulation tests were conducted with a sediment-dwelling aquatic oligochaete (*Lumbriculus variegatus*) as part of the OU4 RI, in support of the ERA. Testing was performed in accordance with the American Society of Testing Materials (ASTM), *Standard Test for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates* (ASTM E1706-05). Laboratory-reared test organisms were used. In addition to laboratory control sediment, sediment collected from the following locations was used in the bioaccumulation tests:

- To evaluate Bound Brook sediments – three locations in Bound Brook (at RM3.01, RM4.85, and RM6.51) and one reference sediment location in Ambrose Brook.
- To evaluate New Market Pond sediments – two locations on the west and east ends of New Market Pond (approximately at RM3.48 and RM4.12) and one reference location on the west end of Lake Nelson.

Sediment for the bioaccumulation testing was collected at the same locations described for sediment toxicity testing.

Sediment samples were analyzed for PCB congeners or PCB Aroclors, pesticides, SVOCs, VOCs, and metals as well as TOC, grain size, and AVS-SEM and used in 28-day bioaccumulation tests. *Lumbriculus variegatus* tissue was analyzed for PCB congeners. At the end of the exposure period, the test organisms were allowed to depurate for 24 hours before collection for analysis. With the exception of deriving site-specific bioaccumulation factors for use in the ERA, these samples were not used in a quantitative assessment of the potential for human health or ecological risks. Therefore, these samples are not listed in Table 2-3.

The OU4 RI sediment collection locations for bioaccumulation testing within the Study Area and reference areas are shown on Figures 2-4 and 2-5, respectively.

2.2.4 Floodplain Soil

Available floodplain soil data are from samples collected for chemical analyses and bioaccumulation testing. The available data and data sets established for this risk assessment are discussed by data type, below.

2.2.4.1 Floodplain Soil Data

OU4 floodplain soil data are available from the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), USEPA's 1997 sediment and soil sampling (USEPA, 1998), USEPA's 1999 floodplain soil and sediment sampling (Weston Solutions, 2000), the Borough of South Plainfield's investigation of Veterans Memorial Park (PMK, 2002), the OU2 RI (Foster Wheeler, 2002), the USEPA ERT sampling conducted in 2007-08 (USEPA, 2008d), and the OU4 RI. Figure 2-3 shows the historic and OU4 RI soil sample locations within each EU in the Study Area.

For this risk assessment, available floodplain soil data were separated into two data sets based on sample depth: Surface Soil and All Soil. Surface Soil samples were considered any soil sample collected from a depth starting between the surface (0 cm) and 30 cm below ground surface. For example, the Surface Soil data set includes samples collected from 0 to 15.24 cm, 0 to 39 cm, and 22.86 to 38.1 cm. Sampling intervals starting at less than 30 cm were considered Surface Soil, even if the sampling interval ended at a depth greater than 30 cm. The All Soil data set comprises all samples, regardless of depth. The deepest floodplain soil sample was collected from 213.36 to 228.6 cm in a test pit to investigate historic fill at Veterans Memorial Park. Therefore, the All Soil data set includes floodplain soil samples collected from depths between 0 and 228.6 cm. Other than sample depth, no other physical or chemical parameters were evaluated to define the Surface Soil and All Soil data sets. Table 2-4 shows the number of Surface Soil and All Soil samples included in each EU and from each investigation. Table 2-4 also indicates the analyses performed on each set of samples. Only the Surface Soil data set (representing soil from the top 30 cm) was used in the ERA.

During the OU4 RI, to characterize soil within the floodplain of the Ambrose Brook reference area, five surface soil samples (0 to 15.24 cm) were collected and analyzed for PCB Aroclors or PCB congeners, pesticides, SVOCs, VOCs, metals, and cyanide as well as TOC and grain size. These soil samples are listed in Table 2-4; the sampling locations are shown on Figure 2-5.

2.2.4.2 Soil Bioaccumulation Testing

Soil bioaccumulation tests were conducted with a terrestrial oligochaete [*i.e.*, earthworms (*Eisenia fetida*)] as part of the OU4 RI, in support of the ERA. Testing was performed in accordance with the USEPA document *Lumbriculus variegatus Bioaccumulation Test for Sediments* (EPA 600R/R-99/064); and ASTM, *Standard Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm E. fetida and the Enchytraeid Potworm Enchytraeus albidus* (ASTM E1676-04). Laboratory-reared test organisms were used. Soil samples were collected from three floodplain locations within the Study Area along Bound Brook (on the south bank near RM3.15, on the north bank near RM5.7, and on the south bank near RM5.8) and from one floodplain location within the reference area along Ambrose Brook.

The sampling locations for soil bioaccumulation tests within the Bound Brook floodplain were selected to satisfy the OU4 RI/FS Work Plan requirements (outlined in Field Modification No. 5) as follows:

- Location near RM5.8 (south bank) – near relatively high reported Aroclor 1254 concentration and to address data gaps in the USEPA's 1997 Ecological Evaluation.

- Location at RM5.7 (north bank) – near relatively high reported Aroclor 1254 concentration and to address data gaps in the USEPA's 1997 Ecological Evaluation.
- Location at RM3.01 (south bank) – located downstream of New Market Pond, near relatively high reported Aroclor 1254 concentration, and to address data gaps in the USEPA's 1997 Ecological Evaluation.

The reference location within the Ambrose Brook floodplain was selected based on similar conditions (*e.g.*, wetland habitat) as the locations in Bound Brook, particularly the location at RM3.01. The Ambrose Brook floodplain was more extensive in area than the Bound Brook floodplain where samples were collected. Accessibility to the reference area locations was also taken into consideration when selecting final sampling locations.

Soil samples were analyzed for PCB congeners or PCB Aroclors, pesticides, SVOCs, VOCs, and metals as well as TOC and grain size and used in 28-day bioaccumulation tests. Earthworm tissue was analyzed for PCB congeners. At the end of the exposure period, the test organisms were allowed to depurate overnight before collection for analysis.

The OU4 RI sediment collection locations for bioaccumulation testing within the Study Area and reference areas are shown on Figures 2-5 and 2-4, respectively.

2.2.5 Biota

Biota samples were collected as part of the USEPA's 1997 Ecological Evaluation (USEPA, 1999a) and 2008/2009 Reassessment (USEPA, 2010a). During the USEPA's 1997 Ecological Evaluation, sampled biota included fish, crayfish (family Cambaridae), and small mammals [*i.e.*, white-footed mouse (*Peromyscus leucopus*)] (USEPA, 1999a). Fish tissue samples were analyzed for TCL pesticides, PCB Aroclors, and TAL metals. Crayfish tissue samples were analyzed for TCL BNA, pesticides, PCB Aroclors, and TAL metals. Small mammal tissue samples were analyzed for TCL pesticides and PCB Aroclors. During the 2008/2009 Reassessment, sampled biota included fish and freshwater Asiatic clams (*Corbicula fluminea*) (USEPA, 2010a). Fish and Asiatic clam tissue samples were analyzed for TCL PCB Aroclors. Fish species sampled during both investigations included pumpkinseed sunfish (*Lepomis gibbosus*), bluegill sunfish (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), carp (*Cyprinus* *carpius*), white sucker (*Catostomus commersonii*), and brown bullhead catfish (*Ameiurus nebulosus*).

Depending on the species and size of the fish, tissue samples were analyzed as fillet, fillet and carcass, or whole body. Crayfish were depurated for 18 to 20 hours and clams were depurated for 24 hours prior to whole body analysis. Mouse whole body tissue homogenate was prepared after the gastrointestinal tracts were removed and the stomach rinsed with distilled water and returned. All biota data were used for the risk assessment data sets, with the exception of fish samples collected from Green Brook, at location A14, downstream of the Study Area boundary.

A total of 188 fish fillet and 140 whole body fish samples were collected from within the Study Area and used in the risk assessment. Fillet and whole body fish samples were separated into two data sets: one for predatory fish (*i.e.*, pumpkinseed and bluegill sunfish and smallmouth bass) and the other for bottom-feeding fish (*i.e.*, carp, white sucker, and brown bullhead catfish). Most fish samples were made up of individual organisms, however, pumpkinseed and bluegill sunfish samples and two white sucker samples from the 2008/2009 Reassessment consisted of composites of multiple organisms. Tables 2-5 and 2-6 list the samples included in the fillet data sets for predatory and bottom-feeding fish. Tables 2-7 and 2-8 list the samples included in the whole body data sets for predatory and bottom-feeding fish. The investigation, sample ID, sample location, corresponding RM, fish species, and chemical analyses are also indicated in each table.

A total of 15 clam samples, 38 crayfish samples, and 32 mouse samples were collected from within the Study Area and used in the risk assessment. Crayfish and mouse samples were made up of individual organisms and clam samples were composites of multiple organisms. Tables 2-9 through 2-11 list the samples included in each data set. The investigation, sample ID, sample location, corresponding RM, and chemical analyses are also indicated.

Figure 2-5 depicts all biota sampling locations.

2.3 Data Usability

The OU4 environmental media samples were analyzed and validated, as indicated in Table 2-12. Generally, the data characteristics used to satisfy the quality assurance/quality control requirements included precision, accuracy, representativeness, comparability, detection limit verification, and blank contamination elimination or qualification. The analytical data combined for this risk assessment were considered to be generally of acceptable quality. The procedures employed by the analytical laboratories were based upon USEPA methods or USEPA Contract Laboratory Program (CLP) statements of work. The historical data were considered generally usable for comparison, as they were previously accepted by the USEPA.

Overall, the analytical data are of acceptable quality, but subject to the data validator's qualifying marks. Data flagged as rejected ("R") were removed from the risk assessment data sets. Data assigned other qualifiers (*e.g.*, indicating the numerical result is an estimated quantity or that the identity and quantity are based on presumptive evidence) were treated the same way as data without such qualifiers. In combining the data and creating data summaries, analytical results of duplicate samples were averaged with those of the parent samples. In calculating the arithmetic average of parent and duplicate samples, if a COPC was detected in one sample but not the other, the positive result was used.

Depending on the investigation, PCB concentrations were determined based on laboratory analysis of Aroclor mixtures and/or analysis of individual PCB congeners. Because the analytical method for PCB congeners detects and quantifies individual and co-eluting PCB congeners, it is generally considered to be more accurate. However, the prevalence of PCB congener data, particularly for the sediment and floodplain soil data sets, is considerably limited when compared to PCB Aroclor data.

As discussed in the OU4 RI Report, when evaluating PCBs in Bound Brook sediments, Aroclor 1254 (which represents mainly the tetrachlorobiphenyl and pentachlorobiphenyl congeners) was the predominant PCB Aroclor mixture identified. However, based on the PCB congener data, lighter PCB congeners (such as dichlorobiphenyl and trichlorobiphenyl) as well as heavier PCB congeners (such as octachlorobiphenyl and nonachlorobiphenyl) were also found to be present in the Bound Brook sediment. Although co-located sediment samples were not simultaneously analyzed for Aroclors and congeners, evaluation of PCB concentrations in sediment based on Aroclors versus congeners indicate that PCB Aroclor data for the OU4 RI sediment samples are biased low. Statistical evaluation of the relationship between PCB concentrations on an Aroclor basis versus PCB concentrations on a congener basis could not be made due to the general lack of co-located sediment samples simultaneously analyzed for PCB Aroclors and PCB congeners.

Although the OU4 RI sediment data indicate PCB concentrations on an Aroclor basis may be biased low, given the insufficient coverage of PCB congener data in sediment and floodplain soil across the OU4 Study Area, only PCB Aroclor data were used in the sediment and floodplain soil data sets. The PCB Aroclor data were used as they were reported, due to the inability to "correct" PCB Aroclor data for the presence of lighter and heavier congeners. While individual PCB Aroclor mixtures were analyzed for, Aroclors were evaluated as "total PCB Aroclors." For the purposes of this risk assessment, total PCB Aroclors was calculated as the sum of detected Aroclor 1242, Aroclor 1254[13], and Aroclor 1260 concentrations within a given sample.

A limited number of biota (*i.e.*, fish and Asiatic clams) samples from the 2008/2009 Reassessment were simultaneously analyzed for both PCB Aroclors and PCB congeners. Contrary to the result for OU4 RI sediment samples, total PCB concentrations on an Aroclor basis (as the sum of Aroclor 1242, Aroclor 1254, and Aroclors 1260) were generally greater than total PCB concentrations on a congener basis. These data were evaluated to determine whether a relationship exists between total PCB Aroclors and total PCB congeners. While the two data sets were correlated, they were also statistically significantly different. In the case of the biota data, adjusting the PCB Aroclors would serve to lower total PCB concentrations. Therefore, PCB Aroclor data in biota samples were not adjusted. Like the sediment and floodplain soil data sets, total PCB Aroclors for all biota data sets (*i.e.*, fish, crayfish, Asiatic clams, and mouse) was calculated as the sum of detected Aroclor 1242, Aroclor 1254, and Aroclor 1260 concentrations within a given sample.

Of the surface water samples collected during the OU4 RI, whole water grab samples were analyzed for PCB Aroclors and samples collected using passive sampling devices were analyzed for PCB congeners. Due to the greater sensitivity of the congener method,

[13] While Aroclor 1248 was detected in one sample, it was determined that significant overlap occurred in the chromatography peaks for Aroclor 1248 and 1254. Therefore only data for Aroclor 1254 were included in the calculation of total PCB Aroclors.

the Aroclor and congener data were not combined in the data summary.[14] Instead, an attempt was made to convert the congener data to Aroclors, because the PCB data for other abiotic media were presented and evaluated as total PCB Aroclors. The laboratory that completed the congener analyses for the OU4 RI samples provided an empirical formula based on sediment to adjust congeners to be on an Aroclor basis (*i.e.*, for Aroclor 1242, Aroclor 1254, and Aroclor 1260). However, based on a quality control check, this formula was not applicable to surface water. Therefore, surface water PCB data are presented in this risk assessment as total PCB congeners; chemical-specific parameters and toxicity values for Aroclor 1254 were applied.

In addition to evaluating exposure to total PCBs, the PCB congener data available for the biota and surface water data sets were also evaluated in terms of the potential for PCBs to exhibit dioxin-like toxicity. The current practice recommended by the USEPA (2010c and 2008c) is to assess mixtures of dioxins/furans and PCBs that exhibit dioxin-like toxicity on the basis of their predicted toxicities relative to what is known about the toxicity of 2,3,7,8-tetrachlorodibenzo(p)dioxin (TCDD). Twelve PCB congeners and seventeen dioxin/furan congeners have been assigned 2,3,7,8-TCDD toxic equivalence factors (TEF) according to the 2005 World Health Organization (WHO) toxic equivalence (TEQ) weighting scheme (USEPA, 2010c) for mammals and the Van der Berg et al. (1998) weighting schemes for fish and birds (USEPA, 2008c). Within a biota or surface water sample, detected concentrations of the twelve PCB congeners with dioxin-like toxicity were multiplied by the congener-specific TEF, and the sum of the adjusted concentrations was calculated as “TCDD TEQ (PCBs)”. For this reason, PCB congeners in the biota and surface water data sets are also presented on a TCDD TEQ (PCBs) basis.

[14] In fact, PCB Aroclors were not detected in the whole water grab samples, but a combined data set could have been used to calculate exposure point concentrations for surface water.

3 Conceptual Site Exposure Models

This section presents the conceptual understanding of the potential for human and ecological exposure to COPCs/COPECs within the Study Area and thereby establishes the exposure scenarios evaluated in this risk assessment. The conceptual site exposure models (CSEM) are informed by the environmental setting, sources of chemical contamination originating from the former CDE facility, chemical mobility and migration pathways, potential environmental exposure media, and potential human and ecological receptors within the Study Area.

The following sections present information on the environmental setting, potential chemical sources, and chemical release and transport mechanisms. The CSEMs for the BHHRA and ERA are presented in, respectively, Sections 3.3 and 3.4.

3.1 Environmental Setting

The area surrounding the former CDE facility is a largely urban environment with principally commercial and light industrial uses to the northeast and east, residential development to the south and directly north, and mixed residential and commercial properties to the west.

Figure 3-1 shows land uses in and adjacent to the Study Area. The majority of the Study Area is shown as either urban area or wetlands associated with the Bound Brook stream corridor. Green Brook, Bound Brook, Cedar Brook, New Market Pond, and Spring Lake are open water. The majority of the surrounding area is urban, which includes residential, commercial, and industrial land uses. There are a few agricultural and forested areas in the surrounding area as well. Upstream of the former CDE facility and the Woodbrook Site, larger areas of wetlands correspond to Dismal Swamp Conservation Area.

3.1.1 Demography

The OU4 Study Area can be characterized overall as an urban area and includes areas of the Borough of Middlesex, Piscataway Township, Borough of South Plainfield, and Edison Township (Figure 1-2).

Based on the population estimates of the 2012 Census (census.gov), the Borough of Middlesex has a population of approximately 13,737 people, which is an increase of 0.7 percent from the 2010 Census, which reported an approximate population of 13,635. In 2010, approximately 63.7 percent of the population was between the ages of 18 and 65; 22.5 percent was under 18 years; and 13.8 percent was 65 years or older. In 2010, the approximate racial breakdown of Middlesex's population includes White (81.2 percent), Black or African American (5.1 percent), Asian (6 percent), and other racial and ethnic groups (7.7 percent). Between 2007 and 2011, the median household income was $84,561, and the percentage of the population of the Borough of Middlesex at or below the poverty level was 1.5 percent.

Based on the population estimate of the 2010 Census (census.gov), Piscataway Township had a population of approximately 56,044 people. Approximately 70.2 percent of the population was between the ages of 18 and 65; 20.1 percent was between the ages of 1 and 18; and 9.7 percent was 65 years or older. The 2010 American Community Survey estimates that the approximate racial breakdown of Piscataway's population includes White (38.5 percent), Black or African American (20.7 percent), Asian (33.4 percent), and other racial and ethnic groups (7.4 percent). The Census Bureau's 2006-2010 American Community Survey indicated that the median household income was $88,428, and the percentage of the population of the Piscataway Township at or below the poverty level was 4.3 percent.

According to the population estimates of the 2012 Census (census.gov), the Borough of South Plainfield has a population of approximately 23,669 people, which is an increase of 1.2 percent from the 2010 Census, which reported an approximate population of 23,385 in the Borough. In 2010, approximately 63.5 percent of the population was between the ages of 18 and 65; 23 percent was under 18 years; and 13.5 percent was 65 years or older. In 2010, the approximate racial breakdown of South Plainfield's population included White (66.7 percent), Black or African American (10.1 percent), Asian (14.7 percent), and other racial and ethnic groups (8.5 percent). Between 2007 and 2011, the median household income was $91,439, and the percentage of the population of the Borough of South Plainfield at or below the poverty level was 3.6 percent. The area within 1.5 miles of the former CDE facility contains eight schools and five parks. Two elementary schools are located approximately 2,000 feet from the former CDE facility (one to the north and one to the south).

Based on the population estimate of the 2010 Census (census.gov), Edison Township had a population of approximately 99,967 people. Approximately 64.7 percent of the population was between the ages of 18 and 65; 22.7 percent was between the ages of 1 and 18; and 12.6 percent was 65 years or older. The 2010 American Community Survey estimates that the approximate racial breakdown of Edison's population included White (44.1 percent), Black or African American (7.1 percent), Asian (43.2 percent), and other racial and ethnic groups (5.6 percent). The Census Bureau's 2006-2010 American Community Survey indicated that the median household income was $86,725, and the percentage of the population of the Edison Township at or below the poverty level was 7.2 percent.

3.1.2 Meteorology

The OU4 Study Area is located in the central-eastern part of Middlesex County and has a humid continental climate typical of the Mid-Atlantic region of the United States characterized by significant variations between summer and winter temperatures. The average temperature differences between summer and winter are approximately over 40 degrees Fahrenheit. During the summer, warm tropical air masses move into New Jersey from the south and southwest. Many of these moist, hot air masses originate over the Gulf of Mexico and flow inland traveling over heated land masses, thereby increasing in temperature prior to reaching New Jersey. The average July temperature in the OU4 Study Area is 75.9 degrees Fahrenheit (based on monthly totals/average temperatures recoded between the years 1980-2010 for Plainfield, New Jersey (NOWData – NOAA Online Weather Data Station 287079) and the highest temperature ever recorded was 106 degrees Fahrenheit in 1936. In the wintertime, the prevailing winds are from the northwest, accompanied with cold air masses from the Great Lakes region and Canada. Outpourings of cold polar air flow east, warmed slightly in their passage across the Midwest and eastern mountains, creating cold weather conditions between the months of November and March. In January, the coldest month of the year, the average temperature is 31.3 degrees Fahrenheit. The average annual temperature is about 53.9 degrees Fahrenheit.

Precipitation typically occurs in the OU4 Study Area evenly throughout the year. NOAA's Point Precipitation Frequency Estimates for its station at Plainfield, New Jersey is the most representative for the OU4 Study Area and provides the following precipitation frequency and severity of storm event estimates: a storm with duration of 60 minutes and average precipitation amount of 1.14 inches is predicted to occur annually, whereas a 60 minute storm producing 2.61 inches of precipitation is predicted to occur once every 50 years on average. The average annual precipitation is approximately 48.44 inches.

3.1.3 Regional (Surface and Bedrock) Geology

The OU4 Study Area lies within the Piedmont Physiographic Province (Fenneman, 1938). The Piedmont is characterized by a wide, rolling plain divided by a series of high ridges, which are developed from folded and faulted sedimentary rocks of Triassic and Jurassic age and igneous rocks of Jurassic age. The highest elevation in the province is Barren Ridge (914 feet above mean sea level) on the northern side of the Hunterdon Plateau, located northwest of the site. Along the foot of the Highlands, the elevation of the Piedmont generally ranges from 300 to 400 feet above sea level. The province slopes from the foot of the Highlands toward its southeastern boundary with the Coastal Plain Province (Fenneman, 1938).

Quaternary and pre-Quaternary glacial and glacial-fluvial deposits overlie bedrock across much of the northern portion of New Jersey. Based on regional surficial geologic mapping for the area, unconsolidated deposits include sandy, silty clay to clayey, silty sand containing some shale, mudstone, and sandstone fragments. These deposits are associated with recent alluvial and wetland (swamp and marsh) deposition, and earlier glaciofluvial plain deposits. Extensive eolian (wind-driven) deposits are present to the south of the OU4 Study Area, derived from the earlier glaciofluvial plain deposits to the north and east of the Study Area. Surficial deposits are generally identified as regolith derived from weathering of shale, mudstone, and sandstone. The unconsolidated deposits are up to 30 feet thick regionally, but are generally less than 10 feet thick (FWENC, 2002) in the vicinity of the former CDE facility.

The OU4 Study Area is located within the Newark Basin, which is a tectonic rift basin that covers roughly 7,500 square kilometers extending from southern New York through New Jersey and into southeastern Pennsylvania. The basin is filled with Triassic- to Jurassic-aged sedimentary and igneous rocks that are tilted, faulted, and locally folded. Most of the tectonic deformation occurred during the Late Triassic to Middle Jurassic.

The Newark Basin is believed to have evolved from a series of smaller, isolated sub-basins occurring along several normal faults early in the Late Triassic (Schlische, 1992). As continental extension continued, the basin grew in width and length and was filled with sedimentary deposits derived from erosion of the Stockton Formation. The Stockton Formation sandstones and conglomerates transition into argillite, mudstone, shale, and siltstone derived from lakebed and mudflat deposits of the Lockatong and Passaic Formations.

The Passaic Formation (historically known as the Brunswick Formation) occupies an upper unit of the Newark Supergroup rocks in the Triassic-Jurassic Newark Basin (Herman, 2001). The bedrock associated with this formation is derived from thousands of feet of sediments that filled the Newark Basin over a period of about 45 million years. The Passaic Formation is the thickest and most extensive unit in the Newark Basin. The Passaic Formation in the northern half of the State has been folded, faulted, and fractured during multiple tectonic events spanning hundreds of millions of years. This has contributed to the highly fractured nature of bedrock in this area. This formation consists of mostly red mudstone, siltstone, and shale derived from lacustrine sediments, with minor fluvial sandstone (Michalski and Britton, 1997). The reddish color originates from the inclusion of hematite-rich sediments, which comprise approximately 5 to 10 percent of the unit. The former CDE facility is located south of the contact between the Passaic Formation mudstone unit and a thinly bedded siltstone/shale unit (Herman, 2001).

The Passaic Formation generally dips at about 5 to 15 degrees to the northwest. At an exposure in the Rahway area (northeast of the facility), the Passaic Formation strikes 50 degrees northeast and dips 9 to 12 degrees to the northwest (FWENC, 2002). The predominant system of fractures at that location strikes about 45 degrees northeast and is mostly vertical. A second, less prominent system strikes 75 degrees northwest and is also nearly vertical (FWENC, 2002).

Three basaltic intrusions occurred during the Lower Jurassic (Herman, 2001): Orange Mt. Basalt (also known as the First Watchung), the Preakness Basalt (also known as the Second Watchung), and the Hook Mt. Basalt (also known as the Third Watchung). These units occur to the north of the OU4 Study Area.

3.1.4 OU4 Study Area Surficial Geology

The surficial geology of the OU4 Study Area is composed primarily of alluvial and glaciofluvial deposits. Downstream of New Market Pond, the stream bed is composed of mainly coarse-grained sediments. Weathered shale, mudstone, and sandstone border a center band of alluvium material at RM3.5. Outcrops of the Passaic formation were visible in the field along the banks of Bound Brook downstream of New Market Pond and near RM3.Glaciofluvial deposits lie to the north of the alluvium material. The band of alluvium deposits extends through RM5, with the stream beds consisting of fine-grained sediments accumulating behind the New Market Pond dam. Eolian material appears at RM3.6 and continues through RM5.0.

By RM6.0, the alluvial deposit narrows and is pinched out by glaciofluvial material and weathered shale, mudstone and sandstone. Outcrops of the Passaic formation were visible in the field along the banks of Bound Brook near the former CDE facility, with the stream bed consisting of weathered, fractured bedrock. These formations dominate until RM6.2, when a thin band of swamp and marsh deposits appears. Wetlands containing phragmites and seeps were observed in the field along the banks of Bound Brook, upstream of the former CDE facility. (These wetlands have been characterized as scrub/shrub, herbaceous, and forested wetlands.) This deposit is bordered to the north by glaciofluvial material and to the south by weathered shale, mudstone, and sandstone. The swamp and marsh deposits begin to expand at RM7.2, ultimately filling in the southern part of the OU4 Study Area by RM7.5 and thinning the zone of glaciofluvial material to the north. At RM7.5, the OU4 Study Area narrows to only include Bound Brook and remains confined to the brook until the eastern end at the Talmadge Road Bridge. This stretch of Bound Brook flows through swamp and marsh deposits.

In Cedar Brook, the area is mostly composed of alluvium deposits bordered to the east and west by glaciofluvial material. No surficial geology information is available for the Spring Lake portion of Cedar Brook, most likely because Spring Lake is a manmade feature.

3.1.5 Regional Hydrogeology

The Passaic Formation generally forms a leaky multi-aquifer system that is hundreds of feet thick. Groundwater movement is primarily through bedding plane fractures and steeply dipping interconnected fractures and dissolution channels. A very limited amount of groundwater flows through the interstitial pore spaces between silt or sand particles because of compaction and cementation of the formation. Differences in permeability between layers resulting from variations in fracturing and weathering may account for many water bearing units.

According to Michalski and others, these water bearing units are generally restricted to bedding planes, intensively fractured seams, and near vertical fractures and joints that are sub-parallel to the strike of the formation in this leaky, multi-layered aquifer system (Michalski, 1990, Michalski and Klepp, 1990, Michalski and Britton, 1997). Michalski and Britton (1997) contend that this is typically true because potential groundwater movement in the down dip direction is either impeded by a reduction in bedding plane apertures at greater depths or groundwater movement along strike is favored over a longer down dip movement path and subsequent up dip movement near a discharge zone. However, groundwater could move in the down dip direction through a fracture network and/or along bedding planes if groundwater movement is affected by pumping wells in the area.

Groundwater in the Passaic Formation is often unconfined in the shallower, more weathered part of the aquifer; however, silt and clay derived from the weathering process typically fill fractures, thereby reducing permeability. This relatively low permeability surface zone reportedly extends 50 to 60 feet bgs (Michalski, 1990). Groundwater in the deeper portion of the Passaic Formation is generally confined as the lack of vertical fractures can create a confining effect with depth. Recharge is by leakage through fractures in the confining units. The transmissivity of mudstone and siltstone units can range from 400 to 14,500 gallons per day per foot (gpd/ft) (Herman, 2001). Local and regional groundwater discharge boundaries include surface water bodies like Bound Brook. However, municipal pumping centers (water wells) account for most of the regional groundwater discharge.

The Passaic Formation contains an aquifer that is used as a source of potable water for some of the communities surrounding the former CDE facility. Numerous private, industrial, and municipal wells tap the formation, with reported pumping rates that range from a few to several hundred gallons per minute. Current groundwater extraction influences regional and local groundwater movement, and the variable historical configuration and pumping of municipal extraction wells exerted a dominant influence on historical groundwater movement at the former CDE facility.

3.1.6 Site-Specific Hydrogeology

The bedrock aquifer investigated as part of the OU3 RI was separated into three hydrogeologic units, or water-bearing zones, identified as the “shallow,” “intermediate,” and “deep.” These zones refer to groundwater depths of up to 120 feet bgs, 120 to 160 feet bgs, and 200 to 240 feet bgs, respectively. They were separated into three water-bearing zones based on the location of monitoring points (ports and screened intervals) for the creation of potentiometric surface and chemical distribution maps. These zones were selected based on the location of ports; however, each of the zones selected does not necessarily coincide with where most of the fractures occurred. Each of these zones is hydraulically connected. The potentiometric surface data and chemical concentrations from these ports were also used in the overall interpretation of groundwater flow and VOC distribution at and downgradient of the former CDE facility.

The shallow water bearing zone is unconfined and extends from the water table to a depth of approximately 120 feet bgs (bedrock). The water table fluctuates from the unconsolidated deposits due to seasonally high recharge and falls into the bedrock during seasonally low recharge and the effects of nearby pumping. Therefore, the groundwater encountered in the unconsolidated deposits is interpreted as part of the shallow unconfined bedrock aquifer. Groundwater in the upper few feet of this water bearing zone is hydraulically connected to surface water bodies including Bound Brook, Cedar Brook, and Spring Lake. Groundwater to a depth of 120 feet bgs has the potential to be hydraulically connected (discharging) to Bound Brook near the former CDE facility. Groundwater in water bearing zones below 120 feet bgs not hydraulically connected to surface water bodies. Even though the aquifer is highly fractured, there is some bedrock structure that produces localized anisotropic conditions. The portion of the groundwater that cannot discharge to Bound Brook, due to the lack of vertical fractures, and the remaining portion of the groundwater from the water bearing zones, migrate to the north-northeast in an arc until eventually reaching a downgradient receptor such as a municipal well.

Water level measurements collected during the OU3 investigation indicated that the potentiometric surface is generally affected by localized discharge to Bound Brook, Cedar Brook, and Spring Lake. Groundwater to a depth of 120 feet bgs moves north and east from the former CDE facility toward Bound Brook, and northwesterly toward the low-lying area at the confluence of Bound Brook and Cedar Brook. To the northeast of the former CDE facility, immediately across Bound Brook, groundwater flow is generally toward the west to a depth of 120 feet bgs, with groundwater discharging to Bound Brook, Cedar Brook, and Spring Lake.

Measurements of groundwater elevations between 120 and 160 feet bgs and between 200 and 240 feet bgs indicated that the generalized direction of groundwater movement is to the north with the gradient generally trending northwest near the former CDE facility before turning to the north-northeast as a result of the influence of local pumping centers. There is no groundwater-surface water interaction exhibited in these depth intervals..

3.1.7 Surface Water Bodies

3.1.7.1 OU4 Bound Brook Study Area

Bound Brook is a moderate-sized, perennial stream with a mild gradient. From its headwaters in Edison Township, just upstream of Dismal Swamp, Bound Brook flows approximately 11 miles to its confluence with Green Brook. Bound Brook drains an area of approximately 24 square miles of primarily residential and commercial/industrial development..

Within and just downstream of Dismal Swamp (approximately RM7.4 to 8.3) the natural floodplain remains intact. Bound Brook is prone to flooding and bank erosion is visible in some areas (*e.g.*, along RM3.0 to 3.4, RM5.5). In general, the stream substrate is medium to coarse sand, with limited areas of fine sand, silt, clay, gravel, cobbles, or hard bottom. Areas in Bound Brook with visible outcropping of the Passaic Formation bedrock occur along RM2.8 to 3.0 and RM6.0 to 6.4.

Bound Brook is impounded at RM3.43 to form the 17.6-acre New Market Pond. New Market Pond was dredged in the mid-1980s to a depth of 3 to 4 feet on the eastern side of the pond and 6 to 8 feet on the western end of the pond by the dam (Piscataway, 1984). A bathymetric survey was performed during the OU4 RI in 2010 to measure the current water depth in the pond. Recorded water depths ranged from approximately 2 to 4 feet in the eastern portion of the pond (between the eastern gazebo and Washington Avenue Bridge) and from 2 to 7 feet in the western side of the pond (between the bridge and New Market Pond dam), with a large section of the western side of the pond having water depths greater than 5 feet.

Two unnamed tributaries flow into Bound Brook, one near New Brunswick Avenue at RM4.7, and one near Elsie Avenue at RM5.5. The third tributary to Bound Brook is Cedar Brook, and its confluence with Bound Brook at RM5.75 is north and downstream from the former CDE facility. Cedar Brook is the largest of the Bound Brook tributaries and drains approximately 6.5 square miles. The average stream gradient is 19 feet/mile (USACE, 1997).

Approximately a half-mile upstream on Cedar Brook is Spring Lake, a man-made impoundment that is surrounded by Spring Lake Park. Spring Lake originally served as a mill pond, dating to the nineteenth century. Accumulating silt deposits compounded by drought and groundwater wells installed by the Middlesex Water Company caused the pond to begin to dry up in the 1950s. By the early 1970s, plans to rehabilitate the lake and create a surrounding park were developed. The Middlesex County Mosquito Commission dredged Cedar Brook and Spring Lake from above the lake to the confluence of Cedar Brook/Bound Brook in the 1970s. Construction of the current lake (covering 6.5 acres based on digitized area of Bing® base map, 2013) and surrounding parkland began in the early 1980s. A constructed spillway controls the discharge flow of Cedar Brook into Bound Brook. The surrounding Spring Lake Park supports secondary contact recreation, including fishing.

The headwaters of Green Brook originate in relatively undeveloped forested areas in the Watchung Mountains and Watchung Reservation. Stream gradients in the upper portion of the subwatershed are relatively steep (*i.e.*, 18.5 feet/mile for Green Brook, 24 feet/mile for Blue Brook in the Watchung Reservation, and 88.1 feet/mile for Stony Brook). Due in part to higher dissolved oxygen in the upper portion of Green Brook, it is classified as FW2-TM (freshwater, trout maintenance) upstream of the confluence of Bound Brook. The gradient in Green Brook quickly becomes more moderate and averages about 8 feet/mile in the lower subwatershed. Green Brook at the confluence with Bound Brook is swift-moving with some visible erosion of banks. The Study Area is within the broad flat basin of the Green Brook watershed. The entire Green Brook basin, including Bound Brook, Ambrose Brook, Bonygutt Brook, Stony Brook, and Middle Brook, is prone to flooding.

3.1.7.2 Reference Areas

As indicated earlier, Ambrose Brook and Lake Nelson were selected as reference areas for the ERA. Similar to Bound Brook, Ambrose Brook is a moderate-sized perennial stream with a mild gradient and is classified as FW2-NT (freshwater, non-trout). Ambrose Brook flows approximately 9 miles from its headwaters into an area of mixed residential and commercial/industrial development, before entering Green Brook. The Ambrose Brook subwatershed drains approximately 14 square miles of predominantly residential and commercial/industrial development.

Ambrose Brook is impounded approximately 2.25 miles downstream of its headwaters to form Lake Nelson, which is privately-owned and maintained by the Lake Nelson Improvement Association. Lake Nelson is rectangular in shape and covers approximately 15 acres. The average depth is 3 feet, and it is 8 feet at its deepest point.

The Ambrose Brook stream channel varies in depth and width. Upstream of Lake Nelson, it was measured to be less than 6 inches deep and 12 feet wide. Available stream flow data collected upstream of Lake Nelson between March and October 2010 indicate flow ranging from 2 to 42 cfs, with an average flow of 12 cfs. The average stream gradient is about 9 feet/mile (USACE, 1997).

3.1.8 Wetlands

NJDEP-mapped wetlands within and in the immediate vicinity of the Study Area are shown on Figure 3-2. Due to the urban nature of the subwatershed, wetlands and vegetated riparian buffer along the Bound Brook stream corridor are somewhat fragmented. According to NJDEP mapping for the region (Figure 3-2), the following wetland types are present in the OU4 Study Area:

- Disturbed Wetlands.
- Scrub/Shrub Wetlands.

- Forested Wetlands.
- Herbaceous Wetlands.
- Managed Wetlands.
- Phragmites-Dominated Interior Wetlands.

The wetland portions of the OU4 Study Area west of New Market Pond are dominated by forested wetlands, with small areas of scrub/shrub, herbaceous, or managed wetlands. The east end of New Market Pond is bordered by forested wetlands to the north. The wetland area extending to the south at RM4 is characterized primarily by forested wetlands, with a small area of managed wetland to the southwest. The wetlands present to the north near RM4.6 are mostly scrub/shrub wetlands, with patches of forested wetlands at the northernmost extent of the OU4 Study Area and the middle and an area of herbaceous wetlands approximately 2/3 of the way to the northern edge. Only about half of the extent of this area is covered by wetlands.

East of New Market Pond, the nature of the wetland areas changes. Forested wetlands are still present, but scrub/shrub, herbaceous, managed, and disturbed wetlands appear more frequently. These other types of wetland dominate between RM5.3 and RM6.0, near the former CDE facility, and along Cedar Brook. Forested wetlands re-appear east of RM7 and have acreages roughly equal to the managed, scrub/shrub, and herbaceous wetlands also in this area. This distribution holds until RM7.5, where the OU4 Study Area narrows to include only Bound Brook until the eastern (upstream) boundary at the Talmadge Road Bridge. This stretch of the brook flows through a mix of wetland types, including forested, scrub/shrub, and herbaceous.

Dismal Swamp Conservation Area, upstream of the OU4 boundary, provides the most extensive area (650 acres) of wetlands in the Site vicinity. These mainly forested wetlands decrease downstream of Dismal Swamp; however, vegetated riparian buffer with overhanging canopy exists along some portions of Bound Brook (*e.g.*, around RM0.4, RM3.0 to 3.4, and RM5.3 to 5.8). Areas of mainly forested wetlands exist along Ambrose Brook, starting just downstream of the headwaters and continuing along most of the remainder of its length.

3.1.9 Potential Ecological Habitat

3.1.9.1 Aquatic Habitat

As noted previously, substrate in Bound Brook is variable and, along much of Bound Brook, is medium to coarse sand with limited areas of fine sand, silt, clay, gravel, cobbles, or hard bottom. Historical information (USEPA, 2013c) indicates the substrate in Bound Brook provided less than 20 percent stable epifaunal habitat suitable for colonization at about RM7.4 and 40 percent to 70 percent stable epifaunal habitat suitable for colonization at about RM0.4. Few small riffles were observed along RM3.0 to 3.4 and RM5.3 to 5.5. Submerged aquatic vegetation (SAV) was observed during a June 2011 habitat characterization survey conducted in selected sections of Bound Brook. Patches of aquatic vegetation were present at RM 3.4, immediately downstream of the New Market Pond spillway, and at the upstream (eastern) end of New Market Pond (approximately RM 4.1), where significant beds were located. Large beds of SAV were also observed in Bound Brook between RM 5.3 – 5.4 and between RM 5.5 and the confluence of Cedar Brook (RM 5.75). Beds of SAV were also present at approximately RM 6.6. Additionally, SAV was observed both at the upstream edge of Spring Lake, where Cedar Brook flows into the lake, and in Cedar Brook immediately downstream of the Spring Lake spillway.

As observed during the June 2011 habitat survey, the banks of Bound Brook near the former CDE facility were described with moderate to no overhanging canopy. The riparian buffer zone was approximately eight feet thick with only grasses and a few small shrubs on a low sloping bank. Downstream of the former CDE facility (at RM5.3, near the Clinton Avenue Bridge), a riparian corridor develops among the wetlands. An overhanging canopy forms in some areas of the wetlands, providing shady areas in the stream (oak and arrowwood observed). Cedar Brook contained in-stream riffle areas, with a well-developed overhanging canopy on steep slopes, providing significant shade over the tributary. Near the confluence of Cedar Brook with Bound Brook, a well-developed riparian corridor exists, with the low sloping banks covered with phragmites and grasses and an overhanging canopy.

Although Ambrose Brook is also known to flood, historical data and field observations indicate that the stream banks were moderately stable and vegetated, providing good overhanging canopy. A normal stream channel was observed upstream of Lake Nelson, while some channelization was observed downstream of Lake Nelson. Based on historical information and field observations, the substrate was variable and similar to Bound Brook, ranging from gravel/cobbles surrounded by fine sediment to mostly silty sand with some partially exposed rocks. A bed of spatterdock was observed in Ambrose Brook upstream of Lake Nelson and at the eastern end of Lake Nelson.

New Market Pond and Lake Nelson, like many of the shallow lakes in the Green Brook basin, are in advanced stages of eutrophication. There are five aerators on New Market Pond and three aerators on Lake Nelson, which generally run between May and October. Both impoundments are relatively shallow, ranging anywhere from 1 to 8 feet deep with bottom substrate composed of organic silty surficial sediment.

3.1.9.2 Terrestrial Habitat

Forested areas adjacent to Bound Brook are vegetated with red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), arrowwood (*Viburnum dentatum*), and various oak (*Quercus*) species. The fields are dominated by tall grasses and brambles (*Rosa* spp. and *Rubus* spp).

A review of the Natural Heritage Database and Landscape Project (Version 3.1) was conducted by the New Jersey Natural Heritage Program in September 2012. The following threatened, endangered, and special concern species were identified as occurring within or in the vicinity (1/4 mile) of the Study Area: redbud (*Cercis Canadensis*) and low spearwort (*Ranunculus pusillus var. pusillus*). The results of the Natural Heritage review are presented in Appendix B.

Forested areas adjacent to Ambrose Brook are vegetated with willow (*Salix* spp.), sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), red maple, silver maple, pin oak (*Quercus palustris*), elm (*Ulmus* spp.), ash (*Fraxinus* spp.), black gum (*Nyssa sylvatica*), spice bush (*Lindera benzoin*), witch hazel (*Hamamelis virginiana*), and arrowwood. SAV was observed in Ambrose Brook upstream of Lake Nelson.

3.1.10 Aquatic Life

Fish collected from Bound Brook, New Market Pond, and Spring Lake during the USEPA’s 1997 Ecological Evaluation and 2008/2009 Reassessment included:

pumpkinseed and bluegill sunfish, smallmouth bass, carp, white sucker, and brown bullhead catfish. The NJDEP Bureau of Freshwater and Biological Monitoring, as part of their ambient biomonitoring network efforts (AMNET), conducted monitoring in Ambrose Brook, downstream of Lake Nelson and relatively close to the confluence with Green Brook, in 2003 and 2008. Fish species identified included: pumpkinseed, bluegill, redbreast (*Lepomis auritus*), and green (*Lepomis cyanellus*) sunfish, black crappie (*Pomoxis nigromaculatus*), smallmouth bass, largemouth bass (*Micropterus salmoides*), white sucker, American eel (*Anguilla rostrata*), common carp, creek chub (*Semotilus atromaculatus*), creek chubsucker (*Erimyzon oblongus*), brown bullhead and yellow bullhead (*Ameiurus natalis*) catfish, spottail shiner (*Notropis hudsonius*), tessellated darter (*Etheostoma olmstedi*), and banded killifish (*Fundulus diaphanus*) (NJDEP, 2012). The fish index of biotic integrity (IBI) rating during both events in Ambrose Brook was ‘Fair’. Given similar habitat and conditions, it is likely that many of these other species found in Ambrose Brook, but not targeted for sampling in Bound Brook (*e.g.*, spottail shiner, tessellated darter, American eel, creek chub), are also present in Bound Brook.

Invertebrates collected in Bound Brook, New Market Pond, and Spring Lake during the USEPA’s 1997 Ecological Evaluation and 2008/2009 Reassessment consisted of: crayfish and Asiatic clam. The non-native Asiatic clam was observed at several locations along Bound Brook from RM3.0 to RM5.5. An unidentified species of pearly mussel was observed in Bound Brook just downstream of the New Market Pond spillway and in Ambrose Brook just downstream of the Lake Nelson spillway. The NJDEP Bureau of Freshwater and Biological Monitoring, as part of AMNET, collected benthic macroinvertebrate data in Bound Brook and Ambrose Brook in 1992, 1999, and 2004. Macroinvertebrate data were collected at two stations in Bound Brook approximately at RM0.4 and RM7.85, with only the station at RM0.4 sampled in 1992, and at two stations in Ambrose Brook, at approximately 0.5 miles upstream of the confluence with Green Brook and 1.5 miles downstream of Lake Nelson, with only the more downstream location sampled in 1992. The biological conditions of macroinvertebrates found in Bound Brook was moderately impaired in all years and severely impaired at the RM7.85 station in 1999. The biological condition of macroinvertebrates was also characterized as moderately impaired in Ambrose Brook in all years. While numerous families of macroinvertebrates were found at the stations in Bound Brook and Ambrose Brook, both water bodies were found to contain a paucity of clean water organisms.

The biota pertinent to this risk assessment (*i.e.*, those biota where tissue concentrations will be used to evaluate the potential for adverse human and ecological health effects) include several species of predatory and bottom-feeding fish and two types of invertebrates. Life history information for these organisms, obtained from a variety on online sources including the NJDEP's Division of Fish and Wildlife website (www.state.nj.us/dep/fgw/fish_warmwater.htm) is briefly summarized below.

Predatory Fish

- Pumpkinseed sunfish - Pumpkinseeds typically reach 6-8 inches in length and typically weigh less than 1 pound. They typically live in warm, calm lakes, ponds and pools of creeks and small rivers with plenty of vegetation and prefer clear water where they can find shelter to hide. They tend to stay near the shore and can be found in numbers within shallow and protected areas. They feed, both at the water surface and the bottom, on a variety of small prey, including insects, mosquito larva, small mollusks and other crustaceans, worms, minnow fry, and even other smaller pumpkinseeds; they occasionally feed on small pieces of vegetation as well. Because they tend to remain in the shallows and feed all day, pumpkinseeds are relatively easy to catch from shore. They will bite at most bait, including garden worms, insects, leeches, or bits of fish. They will also take small artificial lures and can be fished for with a fly rod with wet flies or dry flies. Although they are typically not a popular sport fish due to their small size, some people consider the meat to be good-tasting.
- Bluegill sunfish - Bluegills typically range from 4 to 12 inches in length and typically weigh less than 1 pound. They live in the shallow waters of many lakes and ponds as wells as slow-moving areas of streams and small rivers. The adult diet consists of aquatic insect larvae but also includes crayfish, worms, leeches, snails, and other small fish; if food is scarce, they will also feed on aquatic vegetation. Bluegills are popular panfish.
- Largemouth bass - Adults consume smaller fish, crayfish, and amphibians. They are keenly sought after by anglers and are noted for the excitement of their fight.

Bottom-Feeding Fish

- White sucker - The white sucker is a medium-size fish, reaching up to 18 inches or more in length and up to 8 pounds in weight. Adults are bottom fish and eat mud, plants, mollusks, insects, diatoms, crustaceans, and protozoans. They prefer deeper water in the late fall and winter months but move into shallow water in lakes and riffle areas in streams.

- Common carp - A member of the minnow family, mature carp can weigh 25 to 30 pounds. Although tolerant of most conditions, common carp prefer large bodies of slow or standing water and soft, vegetative sediments. They are omnivorous and can eat a vegetarian diet of water plants, but prefer to scavenge the bottom for insects, crustaceans (including zooplankton), crawfish, and benthic worms. Once considered a nuisance fish, their popularity as quarry is slowly increasing among anglers in the U.S. They are considered excellent table fare, usually smoked or baked.

- Brown bullhead - Brown bullheads are the smallest of the catfishes targeted by New Jersey anglers, typically ranging from 8 to16 inches in length and weighing 1 to -2 pounds. They live in several habitat types, but are found mostly in ponds and the bays of larger lakes, and in slow-moving sections and pools of warm water streams. Brown bullheads are bottom dwellers, usually living over soft mud or muck where there is plenty of underwater vegetation. They are omnivorous bottom feeders and eat a wide variety of plant and animal material including aquatic insects and larvae, worms, minnows and other small fish, crayfish, snails, freshwater clams, and even algae.

Invertebrates

- Crayfish – Crayfish are freshwater crustaceans resembling small lobsters, to which they are related. Members of the family Cambaridae live in eastern North America. They are typically 3 to 6 inches in length. Crayfish are important in terrestrial and freshwater food chains, consuming small fish, earthworms, snails, tadpoles, and plants, and being consumed by fish, salamanders, birds, snakes, mink, raccoons, and many other animals. Like other edible crustaceans, only a small portion of the body of a crayfish is edible. In most prepared dishes only the tail portion is eaten; in other dishes where the entire body is presented, other portions, such as the claw meat, may be eaten.

- Asiatic clam – The Asiatic clam is a species of freshwater clam, considered an invasive species in the U.S. Adults can reach a length of about 2 inches. They feed primarily on phytoplankton, which they filter from the sandy or muddy bottom of streams, lakes, or canals.

3.1.11 Terrestrial and Semi-Aquatic Wildlife

As noted previously, a wildlife species investigation was conducted on several reaches of Bound Brook, from Dismal Swamp to New Market Pond, in December 2008. The investigation consisted of a reconnaissance-level habitat assessment and wildlife species search to identify potential species occurrence in the Bound Brook ecosystem. The findings of the investigation are provided in the *Wildlife Species Investigation of the Bound Brook Ecosystem, South Plainfield, New Jersey* (Stantec, 2008).

During the June 2011 habitat survey, the following fauna were observed in and near Bound Brook: deer fawn, squirrels, raccoon, blue heron (in flight), red-wing blackbird, catbird (heard crying), Canada geese, and frogs (Bull frog calls heard).

The following bird and mammal species were either directly observed or evidence of their presence was found within the Study Area:

Birds	Mammals
Mallard (*Anas platyrhynchos*) Red-tailed hawk (*Buteo jamaicensis*) Eastern wild turkey (*Meleagris gallopavo*) Mourning dove (*Zenaida macroura*) Downy woodpecker (*Picoides pubescens*) Blue jay (*Cyanocitta cristata*) American robin (*Turdus migratorius*) American crow (*Corvus brachyrhynchos*) Fish crow (*Corvus ossifragus*) Black-capped chickadee (*Poecile atricapullus*) Carolina chickadee (*Poecile carolinensis*) Northern cardinal (*Cardinalis cardinalis*) European starling (*Sturnus vulgaris*) Orchard oriole (*Icterus spurius*) Baltimore oriole (*Icterus galbula*) Song sparrow (*Melospiza melodia*)	Eastern chipmunk (*Tamias striatus*) Eastern gray squirrel (*Sciurus carolinensis*) White-footed mouse (*Peromyscus leucopus*) Meadow vole (*Microtus pensylvanicus*) House mouse (*Mus musculus*) Muskrat (*Ondatra zibethicus*) Raccoon (*Procyon lotor*) American Mink (*Neovison vison*) Striped skunk (*Mephitis mephitis*) Fisher (*Martes pennanti*) White-tailed deer (*Odocoileus virginianus*)

The fisher was the most notable mammal species for which tracks and scat were observed within the Study Area. This observation occurred just upstream of the former CDE facility. Habitat suitable for short-tailed shrew was observed near the confluence of Bound Brook and Cedar Brook. Suitable habitat for the red fox was observed upstream of the former CDE facility. Mink (*Neovison vison*) tracks were found upstream of the Study Area along the shore of Bound Brook at the edge of Dismal Swamp. As mink can range over several miles along a stream or river, it is possible that mink may occur within the Study Area.

The New Jersey Audubon Society is conducting bird surveys for the lower Raritan River watershed. Several observation points for this survey are located along Bound Brook (five points between RM5.2 and RM6.1, nine points between RM7.0 and RM8.3, two points in an unnamed tributary near RM5.45, and one point in Cedar Brook upstream of Spring Lake), in Dismal Swamp upstream of the Study Area (eight points upstream of Talmadge Road), and in Ambrose Brook (five points just upstream and downstream of Lake Nelson). Species observed at these locations during the 2012 breeding season (late May through June) and/or spring migration (April through mid-May) surveys and/or observed in Dismal Swamp during surveys conducted in 2008 through 2010 are summarized in Table 3-1. Species observed within the Study Area include American robin (*Turdus migratorius*), mourning dove (*Zenaida macroura*), belted kingfisher

(*Ceryle alcyon*), great blue heron (*Ardea herodias*), red-tailed hawk (*Buteo jamaicensis*), and red-winged blackbird (*Agelaius phoeniceus*).

3.1.11.1 Threatened and Endangered Species

A review of the Natural Heritage Database and Landscape Project (Version 3.1) was conducted by the New Jersey Natural Heritage Program in September 2012 and the following threatened, endangered, and special concern species were identified as occurring within or in the vicinity (1/4 mile) of the Study Area:

- Seven birds – state threatened bald eagle (*Haliaeetus leucocephalus*), state endangered northern harrier (*Circus cyaneus*) and loggerhead shrike (*Lanius ludovicianus*), and state special concern (breeding status) species including: Cooper's hawk (*Accipiter cooperii*), great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), and wood thrush (*Hylocichla* sp); and

- One insect – coastal bog metarranthis (*Metarranthis pilosaria*).

The results of the Natural Heritage review are presented in Appendix B.

An environmental assessment was conducted as part of the Green Brook Flood Control Project (USACE, 2008). As part of this assessment, the United States Army Corps of Engineers (USACE) coordinated with the United States Fish and Wildlife Service (USFWS) to conduct an Indiana bat (*Myotis sodalis*) survey along a section of Middle Brook adjacent to the Raritan River. Although the survey was not within the Study Area, it provides a regional context for bat presence and habitat. The area studied is similarly developed to the Study Area with similar patches of forested wetlands. Mature tree species suitable for roosting sites were found and 29 individual bats were captured during the survey. Species captured included big brown bat (*Eptesieus fuscus*), little brown bat (*Myotis lucifugus*), and eastern red bat (*Lasurus borealis*). No Indiana bats were captured. The USFWS indicates on their online Indana bat species profile (USFWS, 2012) that Indiana bats are known or believed to occur in New Jersey only in Morris, Somerset, Sussex, and Union counties.

3.2 Chemical Sources and Release and Transport Mechanisms

As described previously, CDE disposed of PCB-contaminated materials and other hazardous substances directly on facility soils. Therefore, facility soils have historically been the primary source of chemical contamination to the Bound Brook system. A secondary source of contamination included migration through the former CDE facility's drainage system and direct discharge into Bound Brook. These have been eliminated as continuing sources by placement of a cap during the OU2 ROD implementation.

Discarded capacitors have periodically surfaced along the banks of Bound Brook, particularly just downstream of the twin culverts. The formerly buried capacitors generally were exposed as the result of stream bank erosion. In the spring of 2007, USEPA personnel routinely walked the stream bank to collect capacitors and capacitor debris. In April 2007, the USEPA conducted a removal action to stabilize the stream bank and prevent further erosion in this area by armoring the banks with a geotextile and stone. Therefore, buried capacitors and capacitor components have acted as sources of chemical contamination to the Bound Brook system. This has been mitigated in the vicinity of the former CDE facility by placement of armor on the banks during the USEPA removal action.

Primary release and transport mechanisms that facilitated migration of chemicals from the former CDE facility include surface runoff, direct release to Bound Brook through the former CDE facility's drainage system, bank erosion, and infiltration and percolation through soils to groundwater and subsequent discharge to nearby wetlands and surface water bodies (*e.g.*, Bound Brook).

As described previously, the OU3 RI data demonstrated the potentiometric surface is generally controlled by elevation, with shallow groundwater potentially discharging to Bound Brook, Cedar Brook, and Spring Lake. It is because of the suspected transport of shallow groundwater contaminated with chlorinated VOCs (*i.e.*, TCE and cis-1,2-dichloroethene [cis-1,2-DCE]) and PCBs into Bound Brook that porewater samples were also collected during the OU4 RI. In addition to reporting on the nature and extent of contamination in surface water, sediment, and floodplain soil, the potential for an ongoing contamination source via groundwater discharge to Bound Brook was addressed by the OU4 RI.

Once released to surface water and sediment, the fate and transport of contaminants depends on numerous physiochemical properties (*e.g.*, molecular weight, solubility, vapor pressure) and environmental conditions (*e.g.*, water velocity, sediment particle size, pH). VOCs generally volatilize and undergo photodegradation and usually do not remain in the water column for long distances. Soluble chemicals may partition between the water column and sediment based on their hydrophobicity (*e.g.*, PCBs and polycyclic aromatic hydrocarbons [PAHs]) and other physiochemical conditions such as organic carbon. Metals tend to partition between the water column and sediment based on physiochemical conditions such as pH, carbonate or sulfide concentrations, and organic carbon. Changes in environmental conditions may cause chemicals to sorb to and desorb from sediment. Physiochemical conditions (*e.g.*, dissolved oxygen levels, pH) where groundwater discharges to a surface water body may be quite different than the overlying water column, affecting the fate of contaminants in the transition zone. Microbial activity in the transition zone often creates a steep oxidation-reduction gradient (Fenchel et al. 1988; Wetzel 2001 as cited in USEPA, 2008b), thereby affecting degradation/attenuation of organic chemicals and solubilizing metals.

Contaminated sediment may become resuspended in the water column and deposited elsewhere within the channel or floodplain further downstream. Flooding has the potential to transport and redistribute significant amounts of sediment during storm events, either adding to the sediment loading in the system or contributing to sedimentation in floodplain areas. As described in the OU4 RI Report, evaluation of sediment trap and surficial sediment samples before and after Hurricane Irene and Tropical Storm Lee of 2011 indicate that substantial flooding did not have a pronounced effect on the overall contaminant concentration gradients observed in Bound Brook. While erosion and sediment transport likely occurred, material with a similar contaminant load were transported down Bound Brook. In other words, the pre-storm suspended matter contaminant concentrations are similar to the post-storm suspended matter contaminant concentrations in Bound Brook.

Finally, chemicals can be taken up into biota and, for bioaccumulative chemicals, accumulated in higher trophic level organisms within the food web. Uptake can occur through direct exposure to dissolved chemicals in surface water or porewater, through ingestion of chemicals in abiotic media, and also through ingestion of chemicals accumulated in tissue of prey/dietary items within an organism's diet. Some chemicals, like PCBs, can accumulate within tissues (*e.g.*, lipids or fat tissue) resulting in higher concentrations in tissues than the surrounding environment. Therefore dietary exposure for bioaccumulative chemicals is a prominent exposure pathway.

There are other known and unknown sources of chemical as well as non-chemical stressors that contribute to degraded conditions within the Study Area. These include, for example, non-point sources of pollution, road run-off, and atmospheric deposition. There are no wastewater treatment plants within or upstream of the Study Area. The developed nature of the watershed results in a significant amount of impervious surface which contributes to flashier stream flows and increased stream bank erosion, contributing to the sediment, nutrient, and pollutant loads within the entire watershed.

3.3 Human Health CSEM

The human health CSEM for the Study Area is presented in Figure 3-3 and RAGS Part D Table 1 (see Appendix A). The CSEM is based on the information presented above regarding chemical sources, mobility, and migration pathways and the current and reasonably anticipated future land uses within the Study Area. The CSEM identifies potential environmental exposure media, the human receptor populations most likely to be exposed to COPCs in each exposure medium, and the pathways and routes through which human exposure may occur.

For each potential human exposure scenario, RAGS Part D Table 1 provides the exposure scenario timeframe, medium, exposure medium, exposure point, receptor population, receptor age, exposure route, type of analysis, and rationale for selection or exclusion of an exposure pathway.

The following potential exposure scenarios (*i.e.*, combination of exposure pathways and exposure routes for each potential human receptor population) were considered based on the current and reasonably anticipated future land uses in the Study Area. All of these potential exposure scenarios may be occurring currently and may occur or continue to occur in the foreseeable future. However, it should be noted that while a residential exposure scenario was included in this risk assessment, the potential for exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations.[15] Residential soil samples are evaluated on a case-by-case basis by USEPA risk assessors to determine whether remedial actions should be conducted on residential properties. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures, but instead represents the Reasonable Maximum Exposure (RME) that any receptor population accessing the OU4 floodplain areas may have (*i.e.*, it is unlikely anyone using the floodplain areas would have a greater exposure than that associated with residential use). The residential exposure scenario is a conservative assessment and is thereby protective of most other receptor populations as well.

Current/Future Scenario

- Recreationists/Sportsmen/Anglers[16]: [adults and adolescents (7-18 years old)] who may wade, fish, or otherwise recreate in the Study Area. Potential exposure pathways and routes of exposure include dermal contact with COPCs in surface water; incidental ingestion of and dermal contact with COPCs in sediment and floodplain soil; inhalation of volatile COPCs that may be released from surface water or floodplain soil to outdoor air; and inhalation of particulate COPCs that may be released from floodplain soil to outdoor air.
- Anglers: [adults, adolescents (7-18 years old), and children (0-6 years old)] who may consume locally-caught fish or other biota, such as clams and crayfish. This exposure route is in addition to those already identified for angler adults and adolescents, above. It was assumed adult and adolescent receptors may engage in fishing, clamming, or crabbing and thereby be exposed to COPCs in surface water, sediment, and floodplain soils, but children (0-6 years old) are only likely exposed to COPCs originating from the former CDE facility through consumption of locally-caught fish or other biota in the household.

[15] While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only.
[16] A distinction was made between sportsmen who fish and release their catch, and anglers who may consume their catch.

- Outdoor Workers: (adults) who may work to maintain, repair, and/or clean culverts, spillways, bridges, and other structures in the Study Area. Potential exposure pathways and routes of exposure include dermal contact with COPCs in surface water; incidental ingestion of and dermal contact with COPCs in sediment and floodplain soil; inhalation of volatile COPCs that may be released from surface water or floodplain soil to outdoor air; and inhalation of particulate COPCs that may be released from floodplain soil to outdoor air.
- Residents[17]: [adults and children (0-6 years old)] who live within or near the 100-year floodplain areas included in the Study Area. Potential exposure pathways and routes of exposure include incidental ingestion of and dermal contact with COPCs in floodplain soils; inhalation of volatile COPCs released from floodplain soils to outdoor air; and inhalation of wind-generated particulates released from floodplain soils to outdoor air.
- Commercial/Industrial Workers: (adults) who primarily work outdoors on commercial/industrial properties located within the 100-year floodplain areas included in the Study Area. Potential exposure pathways and routes of exposure include incidental ingestion of and dermal contact with COPCs in floodplain soils; inhalation of volatile COPCs released from floodplain soils to outdoor air; and inhalation of wind-generated particulates released from floodplain soils to outdoor air.
- Construction/Utility Workers: (adults) who may perform short-term intrusive work for construction or utility installation, maintenance, or repair within the Study Area. Potential exposure pathways and routes of exposure include incidental ingestion of and dermal contact with COPCs in floodplain soils; inhalation of volatile COPCs released from floodplain soils to outdoor air; and inhalation of mechanically-generated particulate COPCs released from floodplain soils to outdoor air. As utility lines are known to cross the stream channel in some portions of the Study Area, the potential for exposure of construction/utility workers to COPCs in surface water and sediment is addressed in Section 6.2.2.2.

[17] The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

As shown in Table 3-2, all of the exposure scenarios may be occurring currently and may occur or continue to occur in the foreseeable future, in each EU. However, floodplain soil and crayfish data are not available for EU SL. As a result, the potential for exposure of recreationists/sportsmen/anglers and outdoor workers to floodplain soil and the potential for exposure of anglers to crayfish were not evaluated for EU SL. In addition, the potential for exposure of residents, commercial/industrial workers, and construction/utility workers to floodplain soil in EU SL was not evaluated.

3.4 Ecological CSEM

Evaluating potential exposure pathways is one of the primary tasks of the ecological characterization of a site. For an exposure pathway to be complete, a constituent must be able to travel from the source to ecological receptors and be taken up by the receptors via one or more exposure routes. Ecological exposure pathways are discussed below.

Potentially complete exposure pathways are illustrated in the ecological CSEM, Figure 3-4. Ecological receptors potentially exposed to COPEC in surface water and sediment, currently and in the foreseeable future, include:

- Aquatic plants, benthic invertebrates, freshwater fish, semi-aquatic birds and mammals, and reptiles and amphibians potentially exposed to COPEC in surface water, porewater, and/or sediment and bioaccumulated into dietary items.
- Terrestrial birds and mammals that may use Bound Brook and its tributaries and impoundments as a water source.

Ecological receptors potentially exposed to COPEC in floodplain soil, currently and in the foreseeable future, include:

- Terrestrial plants, soil invertebrates, birds, mammals, reptiles, and amphibians potentially exposed to COPEC in floodplain soil and bioaccumulated into dietary items.

Ecological receptors are exposed to COPEC in abiotic media through direct contact (including respiration for fish) and both intentional (*e.g.*, drinking surface water) and incidental (*e.g.*, soil or sediment entrained in dietary items) ingestion. Ecological receptors are exposed through intentional ingestion of COPEC bioaccumulated into the plant and animal tissues that make up their diets. Exposure of birds and mammals to COPEC dermally absorbed following contact with abiotic media or through inhalation of volatile emissions or particulates released from abiotic media, while possible, was not included in this risk assessment due to the general lack of information needed to evaluate these routes of exposure. In addition, the potential for adverse health effects on reptile and amphibian populations was evaluated qualitatively in Section 6, “Uncertainty Evaluation” due to the general lack of readily available information on metabolism and toxicity in these potential receptors.

4 Baseline Human Health Risk Assessment

This BHHRA evaluates the potential for adverse human health effects associated with exposure to chemicals detected in environmental samples from the Study Area. The BHHRA follows the four-step process typically used to assess potential human health risks and hazards (USEPA, 1989; NRC, 1983). The four steps are:

- **Data Evaluation**: COPCs in surface water, sediment, floodplain soil, and biota are identified for further evaluation.
- **Exposure Assessment**: Concentrations of COPCs at points of potential human exposure are determined, and human exposures to the COPCs are estimated.
- **Toxicity Assessment**: Qualitative and quantitative toxicity information for each COPC is summarized and toxicity values used to characterize the potential for adverse human health effects are identified.
- **Risk Characterization**: The likelihood and magnitude of adverse health effects, in the form of incremental lifetime cancer risks and non-cancer hazards, are estimated.

The selection of COPCs and calculation of chemical concentrations at points of potential human exposure (termed exposure point concentrations [EPC]) are based on the risk assessment data sets described in Section 2.2. The equations and parameter values used to model exposures are based on the human health CSEM presented in Section 3.3, RAGS Part D Table 1 (see Appendix A), and Figure 3-3.

4.1 Identification of Chemicals of Potential Concern

To focus the BHHRA on those chemicals that, if contacted, have the greatest potential to pose human health risks, the list of detected chemicals in each sampled environmental medium was narrowed to a list of COPCs according to the following screening process:

- Chemicals designated by the USEPA as Class A or known human carcinogens were identified as COPCs regardless of the other selection criteria. The following chemicals detected in environmental samples from the Study Area are Class A or known human carcinogens: benzene, trichloroethene, and arsenic.

- Detected chemical concentrations were compared to the USEPA Regional Screening Levels (RSL) (USEPA, 2012c). The RSLs are based on a target cancer risk of 10^{-6} or a target non-cancer hazard quotient (HQ) of 1. Consistent with USEPA, Region 2 guidance for screening sites with multiple contaminants, RSLs based on non-cancer effects were reduced by a factor of 10 to represent a target HQ of 0.1. Chemicals with maximum concentrations greater than the screening levels were identified as COPCs. More information on the particular RSLs used to select COPCs in each data set is presented by exposure medium below.
- Essential nutrients (*i.e.*, calcium, magnesium, potassium, and sodium) were categorically eliminated as COPCs.
- Finally, following USEPA (1989) guidance, for sample sizes greater than or equal to 20, if the detection frequency of a chemical was less than 5 percent and chemical contamination was not biased toward any given area and was not believed to be site-related, it was eliminated as a COPC.
- With few exceptions, detected chemicals without RSLs were retained as COPCs; they were only eliminated as COPCs where they were infrequently detected (as defined above).

Data summaries by environmental medium, and by EU where applicable, and the selection of COPCs are presented in RAGS Part D Tables 2.1 to 2.36 (see Appendix A). The range of detected concentrations, data qualifiers, location of maximum detected concentration, frequency of detection, range of detection limits, concentration used for screening, screening toxicity value (*i.e.*, USEPA RSL), COPC flag, and the rationale for elimination or selection of a chemical as a COPC are provided in each table. Background values for inorganic chemicals were presented for information purposes only but were not considered in the COPC selection process.

While individual PCB Aroclor mixtures were analyzed for, selection of PCB Aroclors as a COPC was based on data for "total PCB Aroclors." For the purposes of this OU4, total PCB Aroclors was calculated as the sum of detected Aroclor 1242, Aroclor 1254, and Aroclor 1260 concentrations within a given sample. Toxicity values used to evaluate the potential for human health risk were specific to Aroclor 1254 or total PCBs, as available.

4.1.1 Surface Water

As indicated in Section 2.2.1, the only surface water data used to evaluate the potential for adverse human health effects are from the OU4 RI samples. These data represent the most recent samples and span the entire Study Area. Older surface water data are discussed in comparison to the OU4 RI data but were not included in the risk assessment data set.

Data from porewater samples collected during the OU4 RI were also evaluated in comparison to the OU4 RI surface water data but were not considered a separate risk assessment data set for the BHHRA. A summary of the porewater data is provided below, and maximum concentrations are compared to chemical-specific RSLs, but COPCs in porewater were not identified for quantitative assessment.

4.1.1.1 COPCs in Surface Water

RAGS Part D Table 2.1 presents the OU4 RI surface water data summary and selection of COPCs for this BHHRA. As indicated in Section 2.2.1, surface water data were evaluated system-wide and were not separated into data sets by EU. COPCs in surface water were identified by comparing detected chemical concentrations to the USEPA RSLs for tapwater (USEPA, 2012c). The RSLs for tapwater are protective of chronic exposures via ingestion and inhalation (of volatile chemicals only) routes; exposure via dermal contact was not included in the derivation of RSLs for tapwater.

Of the chemicals analyzed for in the whole water grab samples collected in September 2011, only four VOCs (*i.e.*, 2-butanone, chlorobenzene, cis-1,2-DCE, and TCE) and metals were detected. The PCB congener and TCDD TEQ (PCBs) data are from the surface water samples collected as part of the porewater study in July-August 2012.

The following chemicals were identified as COPCs in surface water for this BHHRA: cis-1,2-DCE, TCE, total PCB congeners, arsenic, cyanide, and manganese. Based on comparison of the ranges of detected metals concentrations to background values (*i.e.*, concentrations detected in the most upstream surface water sample), metals in the OU4 RI surface water samples may reflect background conditions.

4.1.1.2 Historical Surface Water Data Evaluation

The older or historical OU4 surface water data are from the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), the USEPA ERT sampling conducted in 2007-08, and the RI[18] of the Woodbrook Site (TRC Environmental Corporation, 2007). Surface water data collected for the USEPA's 1997 Ecological Evaluation are not discussed further, as they are 15 years old. Surface water samples collected by the USEPA's ERT in 2007-08 were analyzed for PCBs Aroclors, which were all non-detect at 1 µg/L (USEPA, 2008d). This reporting limit is greater than the RSL for tapwater for each individual Aroclor mixture listed on USEPA's table (USEPA, 2012c). Thus, PCB Aroclors may be present in surface water samples collected by the USEPA ERT in 2007-08 at concentrations greater than screening toxicity values.

Table 4-1 presents a summary (*i.e.*, frequency of detection and range of detected concentrations) of the Bound Brook surface water data from the RI of the Woodbrook Site (TRC Environmental Corporation, 2007). Based on comparison of the maximum detected concentrations to USEPA RSLs for tapwater, the following chemicals exceed COPC screening criteria: TCE, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, cadmium, manganese, and thallium.

TCE, arsenic, and manganese were already identified as COPCs in the OU4 RI surface water data, and detected TCE and arsenic concentrations were greater in the OU4 RI samples than in the Woodbrook Site RI samples. Therefore, the potential for adverse health effects from exposure to these chemicals is addressed by this BHHRA. Cadmium, thallium, and PAHs were analyzed for but not detected in the OU4 RI surface water samples. Further evaluation of the PAH data in particular shows the reporting limits to be relatively elevated in the OU4 RI samples. For example, benzo(a)pyrene was not detected in the OU4 RI surface water samples but at reporting limits of 5 or 5.1 µg/L, which are greater than the chemical-specific RSL of 0.0029 µg/L. Therefore, PAHs may be present

[18] As indicated in Section 1.3.8, of the analytical data available from the RI of the Woodbrook Road Dump Superfund Site, only surface water and sediment data from sample locations on Bound Brook were considered for inclusion in this risk assessment. Surface water and sediment data from other watercourses sampled as part of the Woodbrook Road RI were not considered for inclusion, as they are not within the OU4 boundary.

in the OU4 RI surface water samples at concentrations similar to those found in the Woodbrook Site RI samples and at concentrations potentially greater than screening toxicity values.

This evaluation of the Bound Brook surface water data from the Woodbrook Site RI indicates the OU4 RI surface water data likely adequately represent VOC and metals concentrations but may be under-reporting PAHs. Additional discussion of reporting limits for non-detected chemicals and the potential associated impact on this BHHRA is included in Section 6.1.

4.1.1.3 Porewater Data Evaluation

Porewater samples were collected during the OU4 RI to determine the potential for shallow groundwater discharge to Bound Brook sediments and surface water and, if possible, to determine potential discharge points. Porewater was not intended to represent a potential human exposure medium; therefore, COPCs in porewater were not identified for quantitative assessment.

However, the porewater data were evaluated by comparison to the screening criteria used to identify surface water COPCs. Table 4-2 presents a summary (*i.e.*, frequency of detection and range of detected concentrations) of the porewater data collected in July and August 2012. Based on comparison of maximum detected concentrations to the USEPA RSLs for tapwater, the following chemicals exceed COPC screening criteria: benzene, 1,4-dichlorobenzene, 1,1-dichloroethane, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), TCE, vinyl chloride, total PCB congeners, and TCDD TEQ (PCBs).

As indicated above, cis-1,2-DCE, TCE, and total PCB congeners were already identified as COPCs in the OU4 RI surface water samples. The other VOCs in porewater that exceed COPC screening criteria were not detected in the OU4 RI surface water samples. While TCDD TEQ (PCBs) was not identified as a COPC in the OU4 RI surface water samples, concentrations in porewater only exceeded the RSL in the deeper samples (*i.e.*, from depths greater than 10cm beneath the sediment surface), to which humans are less likely to be exposed.

The human health CSEM considers human exposure to chemicals in surface water, and while porewater concentrations may be indicative of surface water concentrations at the sediment-water interface, the chemicals that would be identified as COPCs in porewater are either already surface water COPCs (and therefore addressed by this BHHRA), were not detected in surface water, or were only detected in samples deeper than human exposure would likely occur. However, maximum concentrations of cis-1,2-DCE and TCE detected in porewater are greater than maximum surface water concentrations. For cis-1,2-DCE, the maximum porewater concentration (4,000 µg/L) is orders of magnitude greater than in surface water (8.8 µg/L). As documented in the RI Report Section 7, multiple lines of evidence from the OU3 and OU4 investigations strongly suggest groundwater is an on-going source of PCB and chlorinated solvent (*i.e.,*VOC) contamination to porewater, surface water, and sediments in Bound Brook near the former CDE facility. Under the current hydraulic flow regime, it is possible VOCs not detected in surface water may be present in porewater and eventually discharge to surface water, and where detected in both media, porewater concentrations may be greater than in surface water.

4.1.2 Sediment

As described in Section 2.2.3, sediment data were separated into two data sets based on sample depth: Surface Sediment and All Sediment. COPCs were identified in each data set, and the potential for exposure and adverse health effects was evaluated for different receptor populations according to the human health CSEM.

Data from surface sediment samples collected from a pond at Veterans Memorial Park were also summarized and compared to screening toxicity values. As the park is located within EU BB4, the pond sediment data are discussed in comparison to surface sediment data from EU BB4 but were not included in the risk assessment data set.

4.1.2.1 COPCs in Sediment

RAGS Part D Tables 2.2 to 2.16 present a data summary and the selection of COPCs for each sediment data set, separated by EU and sample depth (*i.e.*, surface sediment or all sediment). As the USEPA does not have human health risk-based screening toxicity values for sediment, COPCs in sediment were identified by comparing detected chemical concentrations to the USEPA RSLs for resident soil (USEPA, 2012c). The RSLs for resident soil are protective of chronic exposures via ingestion, dermal contact, and inhalation (of volatile and particulate chemicals) routes.

Table 4-4 provides a summary of the COPCs identified in this BHHRA and presents a list of COPCs identified in each sediment data set. As shown for sediment, cis-1,2-DCE and vinyl chloride were identified as COPCs in surface sediment and all sediment of BB5[19] but in no other EU. Other COPCs unique to sediment of BB5 are 1,3-dichlorobenzene, gamma-BHC, gamma-chlordane, 4,4'-dichlorodiphenyldichloroethylene (4,4-DDE), 4,4'-dichlorodiphenyltrichloroethane (4,4-DDT), endrin, antimony, and cyanide. Many PAHs (*i.e.*, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene), and phenanthrene) and select metals (*i.e.*, aluminum, arsenic, cobalt, iron, and manganese) were identified as COPCs in every sediment data set and may be representative of system-wide sediment quality. Additional chemicals, including some PAHs, pesticides (endrin aldehyde and endrin ketone), and metals (cadmium and vanadium) were also identified as COPCs in many sediment data sets and may also represent system-wide sediment quality.

4.1.2.2 Veterans Memorial Park Sediment Data Evaluation

Table 4-3 presents summaries (*i.e.*, frequency of detection and range of detected concentrations) of the surface sediment data from the pond at Veterans Memorial Park. Based on comparison of maximum detected concentrations to USEPA RSLs for resident soil, the following chemicals exceed COPC screening criteria: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, total PCB Aroclors, antimony, arsenic, cadmium, and nickel.

Total PCB Aroclors, arsenic, cadmium, and all of the PAHs except benzo(k)fluoranthene were also identified as COPCs in the EU BB4 Surface Sediment data set. In addition, detected concentrations of the PAHs in surface sediment of EU BB4 were greater than in the pond sediment samples. The maximum concentration of benzo(k)anthracene (1.7 mg/kg) detected in pond sediments is only slightly greater than the RSL of 1.5 mg/kg. Therefore, the potential for adverse health effects from exposure to PAHs in pond sediments is likely addressed by this BHHRA.

The maximum detected concentration of total PCB Aroclors in pond sediments, however, was 52.6 mg/kg, which is greater than the maximum concentration of 39 mg/kg in the EU

[19] The former CDE facility is within EU BB5.

BB4 Surface Sediment data set and is also greater than any of the EPCs used to evaluate exposure to total PCB Aroclors in surface sediment. Similarly, maximum detected concentrations of the metal COPCs in pond sediments were greater than surface sediment concentrations from EU BB4. Considering that the pond sediment data sets are relatively limited in terms of sample size, the extent to which detected concentrations are representative of average conditions is unknown. Based on this qualitative assessment, the potential for adverse health effects from recreational exposure to PCBs and select metals in surface sediment of the pond at Veterans Memorial Park may be an area of uncertainty, in that it is not addressed by this BHHRA. Further discussion and an uncertainty analysis are presented in Section 6.

4.1.3 Floodplain Soil

RAGS Part D Tables 2.17 to 2.30 present a data summary and the selection of COPCs for each floodplain soil data set, separated by EU and sample depth (*i.e.*, Surface Soil or All Soil). As for sediment, COPCs in floodplain soil were identified by comparing detected chemical concentrations to the USEPA RSLs for resident soil (USEPA, 2012c).

As shown in Table 4-4 for floodplain soil, cis-1,2-DCE was identified as a COPC in Surface Soil and All Soil of BB5 but in no other EU. 4,4-DDE is the only other COPC unique to soil of BB5. Many PAHs (*i.e.*, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene), and phenanthrene) and select metals (*i.e.*, aluminum, arsenic, cobalt, iron, and manganese) were identified as COPCs in every floodplain soil data set and may be representative of system-wide soil quality. Additional chemicals, including some PAHs, pesticides, and metals (cadmium and vanadium) were also identified as COPCs in many floodplain soil data sets and may also represent system-wide soil quality. Total PCB Aroclors was identified as a COPC in every floodplain soil data set but is a site-related contaminant.

4.1.4 Biota

The biota data relevant to the BHHRA are from the fish fillet, Asiatic clam, and crayfish samples described in Section 2.2.5, as fish, clams, and crayfish from the Study Area may be caught and consumed. To select COPCs in biota, tissue samples were not separated into data sets by EU. However, as previously described, fish fillet samples were separated into two data sets: one for predatory fish (*i.e.*, pumpkinseed and bluegill sunfish and smallmouth bass) and the other for bottom-feeding fish (*i.e.*, carp, white sucker, and brown bullhead catfish). In addition, fish fillet data from Spring Lake were summarized separately.

RAGS Part D Tables 2.31 to 2.34 present a data summary and the selection of COPCs for each fish fillet data set. COPCs in fish were identified by comparing detected chemical concentrations to USEPA RSLs protective of chronic exposures via fish ingestion (USEPA, 2012d). The RSLs for fish were derived using the USEPA default fish ingestion rate for recreational fishers of 54 g/day, which is an average consumption rate approximately equivalent to two 8-ounce servings per week (USEPA, 1991). This default fish ingestion rate is likely conservative for the Study Area but is appropriate for identifying COPCs for further evaluation.

As shown in Table 4-4, the following chemicals were identified as COPCs in all of the fish fillet data sets: 4,4-DDE, heptachlor epoxide, total PCB Aroclors, TCDD TEQ (PCBs), and mercury. Other pesticides, including alpha- and gamma-chlordane, and metals are also COPCs in fish fillet from the Study Area, but these are not site-related contaminants.

RAGS Part D Tables 2.35 and 2.36 present data summaries and the selection of COPCs for, respectively, Asiatic clams and crayfish. COPCs in clams and crayfish were identified by comparing detected chemical concentrations to USEPA RSLs protective of chronic exposures via fish ingestion, which were derived using an ingestion rate of 4.4 g/day, approximately equivalent to 8.2 percent of 54 g/day. This percentage is based on data from Stern et al., 1996 (as presented in USEPA, 2011), which indicates 8.2 percent of all fish meals consumed were shellfish/clams. A shellfish ingestion rate of 4.4 g/day is also likely conservative for the Study Area but is again appropriate for identifying COPCs for further evaluation. As shown in RAGS Part D Table 2.35, total PCB Aroclors and TCDD TEQ (PCBs) were identified as COPCs in Asiatic clams. As shown in RAGS Part D Table 2.36, total PCB Aroclors, arsenic, and lead were identified as COPCs in crayfish.

4.2 Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of human exposure to the COPCs identified in each sampled environmental medium. The human exposure scenarios evaluated in this BHHRA are based on the current and reasonably anticipated future land uses within the Study Area. Potential human receptor populations and the conceptual understanding of the potential for human exposure to COPCs originating from the former CDE facility were established in the human health CSEM. This section therefore presents the approach used to estimate representative EPCs and the equations and parameter values used to model human exposures.

Estimates of chemical intake and exposure were developed to portray reasonable maximum exposure (previously defined as RME) under current and future exposure scenarios. The RME scenario considers the highest exposure that might reasonably be expected to occur, one that is well above the average case of exposure but within the range of possibility. Use of RME parameter values to model baseline human health risks is a conservative approach, in that it yields upper bound cancer risk and non-cancer hazard estimates (USEPA, 1989). In accordance with USEPA Region 2 guidance, if risks in excess of USEPA acceptable levels were determined for an exposure pathway, the pathway was then re-evaluated using central tendency exposure (CTE) parameter values, where applicable, in place of upper-bound values specific to the RME analysis (USEPA, 1995a).

4.2.1 Exposure Point Concentrations

EPCs for each COPC were calculated using the risk assessment data sets described in Section 2 and summarized in the RAGS Part D Table 2s (see Appendix A). The following sections describe the approaches used to calculate EPCs for each COPC in surface water, sediment, or floodplain soil; to calculate EPCs in outdoor air for the COPCs in floodplain soil; and to determine EPCs representative of fish fillet and clams/crayfish that may be caught in the Study Area and subsequently consumed.

4.2.1.1 EPCs in Surface Water, Sediment, and Floodplain Soil

The USEPA (1992a, 1989) recommends that the arithmetic average concentration of the data be used for evaluating long-term exposure and that, because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (95% UCL) on the arithmetic average be used as the EPC. The 95% UCL concentration provides reasonable confidence that the true average will not be under-estimated. The USEPA also indicates that where there is a question about the distribution of the data, a statistical test should be used to identify the best distributional assumption for the data set (USEPA, 1992a).

The ProUCL® 4.1.00 (ProUCL) program developed by the USEPA's Technology Support Center for Monitoring and Site Characterization was used to plot the data, test the distributional assumptions, and calculate 95% UCL concentrations. When entering data into ProUCL, if a COPC was not detected in a sample, the sample reporting limit was entered as a proxy concentration and the sample result was coded as non-detect. ProUCL contains rigorous parametric and nonparametric statistical methods that can be used on full or uncensored data sets and on data sets with below detection limit observations (also called left-censored data sets). Depending on the distribution and 95% UCL estimation method, ProUCL will use only detected data or will incorporate detection limits (USEPA, 2010a). In instances where the 95% UCL concentration calculated by ProUCL was greater than the maximum detected concentration, the maximum concentration was retained as the EPC.

In addition, the USEPA (2010a) indicates that statistical estimates of EPCs may not be reliable for data sets having a large percentage of non-detects. For data sets with a high percentage of non-detects, the EPC may instead be estimated using simple *ad hoc* methods (*e.g.*, using the median or mode). Consistent with USEPA guidance, statistical estimates of EPCs were not made for data sets with less than four samples or with greater than 70 percent non-detects. However, rather than using the median or mode, the maximum detected concentration was retained as the EPC.

Due to the difference in approach for evaluating exposures to lead, the arithmetic mean lead concentrations were used as the EPCs for lead, where applicable.

The EPCs for the COPCs in surface water and each sediment and floodplain soil data set are presented in RAGS Part D Tables 3.1 to 3.30. The ProUCL output sheets for individual COPCs are provided in Appendix C.

4.2.1.2 EPCs in Outdoor Air

The human health CSEM identified the potential for inhalation exposure to VOCs and particulates released from floodplain soil to outdoor air. However, the only volatile COPCs identified in floodplain soil were cis-1,2-dichloroethene, acenaphthylene, and phenanthrene, and inhalation toxicity values are not available for these chemicals. Therefore, concentrations of the volatile COPCs in outdoor air were not estimated and inhalation exposures to volatile COPCs in floodplain soil were not evaluated.

EPCs for the non-volatile COPCs in outdoor air were based on the EPCs for those COPCs in floodplain soil. The techniques used to estimate non-volatile COPC emissions, dispersion, and concentrations in outdoor air are outlined below and presented in greater detail in Appendix D.

The BHHRA assumes that current/future recreationists/sportsmen/anglers, outdoor workers, residents, and commercial/industrial workers may be exposed to wind-generated respirable particulates emitted from floodplain soil exposed at the surface (*i.e.,* Surface Soil or All Soil data, depending on the particular receptor) to outdoor air. Concentrations of the non-volatile COPCs in outdoor air were estimated using a semi-site-specific particulate emission factor (PEF) calculated using equations from the *Supplemental Guidance for Developing Soil Screening Levels* (USEPA, 2002b). The PEF equation and input parameter values are described in Appendix D.

The BHHRA also assumes current/future construction/utility workers may be exposed to respirable particulates in outdoor air above an excavation for construction/utility work. Emissions of the non-volatile COPCs in All Soil were estimated using an equation recommended by the USEPA (1993a), assuming that COPCs associated with respirable particulates are released to outdoor air during the digging of the excavation (USEPA, 1992b). Unitized impacts for respirable particulates, generated from excavation of the soil and subsequent dumping onto temporary storage piles, were modeled as a volume source using the USEPA-approved SCREEN3 Model, Version 96043 (USEPA, 1995b). Screening-level meteorological data were used. COPC concentrations in outdoor air (mg/m^3) were estimated by multiplying the COPC emission rates (in units of g/s) by the unitized impact (in units of [$\mu g/m^3$ per g/s] for particulates) generated by SCREEN3.

4.2.1.3 EPCs in Biota

A statistical evaluation of the biota data was performed to evaluate temporal and spatial patterns in total PCB concentrations and to assist in determining whether data collected at different stations throughout the Study Area were statistically significantly different or not. Analysis of covariance (ANCOVA) was used to evaluate whether mean total PCB concentrations (*i.e.*, the dependent variable) were statistically different between sample populations, while statistically controlling for the effects of other variables that are not of interest (*i.e.*, covariates). More detail and the results of these evaluations are presented in Appendix E.

For fish fillet, the ANCOVA demonstrated there were no statistical differences between total PCB concentrations in 1997 and 2008. Total PCB concentrations in bottom-feeding fish were higher than corresponding concentrations in predatory fish. When sampling locations were tested separately for differences, using both the 1997 and 2008 fish tissue data, ANCOVA indicated total PCB concentrations at Location A9 (upstream of the former CDE facility) were statistically significantly different than concentrations at other locations. Additional relationships are documented in Appendix E.

Based on these evaluations, the following approach was used to group the fish fillet tissue data and calculate EPCs:

- Data from the 1997 and 2008 sampling events were combined.
- Data for bottom-feeding fish and predatory fish were evaluated separately.
- Data from Location A9 were evaluated separately and applied to EU BB6.
- Data from Locations A1 and S3 were combined and applied to EU BB5.
- Data from Locations A2 and A3 were combined and applied to EU BB4 and EU BB3.
- Data from Locations A4 and A5 were combined and applied to EU BB2.
- Data from Locations A11, A12, and A13 were combined and applied to EU BB1 and EU GB.
- Data from Spring Lake were applied to EU SL.

For Asiatic clam data from 2008, the following approach was used to group the data from different stations and calculate EPCs:

- Data from Location A1 were evaluated separately and applied to EU BB6.
- Data from Locations A2, A3, A4, and A5 were combined and applied to EU BB5, EU BB4, EU BB3, EU BB2, EU BB1, EU GB, and EU SL (as no Asiatic clam data are available from Spring Lake).

For crayfish data from 1997, the following approach was used to group the data from different stations and calculate EPCs:

- Data from Location A9 were evaluated separately and applied to EU BB6.
- Data from Locations A1, A2, A3, A4, and A5 were combined and applied to EU BB5, EU BB4, EU BB3, EU BB2, EU BB1, EU GB, and EU SL (as no crayfish data are available from Spring Lake).

The EPCs for the COPCs in fish fillet, Asiatic clams, and crayfish are presented in RAGS Part D Tables 3.31 to 3.36. Where applicable, the ProUCL output sheets for individual COPCs are provided in Appendix C.

4.2.2 Exposure Equations

The equations used to estimate human exposure are presented below and in RAGS Part D Tables 4.1 to 4.20 (see Appendix A). Chronic exposures were estimated for current/future recreationists/sportsmen/anglers, residents, and commercial/industrial workers. For current/future outdoor workers and construction/utility workers, where the exposure duration (ED) is assumed to be one year, subchronic exposures were estimated.

Exposure was generally estimated from the following generic equation (USEPA, 1989):

$$DI = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

Where:

DI = daily intake; the amount of chemical at the exchange boundary (*e.g.*, mg/kg body weight-day)

C = chemical concentration in exposure medium (*i.e.*, the EPC); generally the 95% UCL on the average concentration contacted over the exposure period (*e.g.*, mg/kg sediment)
CR = contact rate; the amount of contaminated medium contacted per unit time (*e.g.*, mg/day)
EF = exposure frequency; describes how often exposure occurs (*e.g.*, days/year)
ED = exposure duration; describes how long exposure occurs (*e.g.*, years)
BW = body weight; the average body weight over the exposure period (kg)
AT = averaging time; the period over which exposure is averaged (*e.g.*, days)

4.2.2.1 Oral and Dermal Exposures

The following equations were used to estimate oral exposure to sediment, floodplain soil, and biota and dermal exposure to surface water, sediment, and floodplain soil:

Oral exposure to sediment and floodplain soil

$$DI = \frac{C \times CF \times IR \times FI \times EF \times ED}{BW \times AT}$$

Where:

C = C_{sed} or C_{soil} = chemical concentration in sediment and floodplain soil, respectively
CF = units conversion factor (1E-06 kg/mg)
IR = ingestion rate of sediment (IR-Sed) or flooplain soil (IR-S) (mg/day)
FI = fraction ingested from contaminated source (unitless)

Oral exposure to biota

$$DI = \frac{C \times CF \times IR \times FI \times (1 - CL) \times EF \times ED}{BW \times AT}$$

Where:

C = C_{fish} or C_{inv} = chemical concentration in fish and invertebrates, respectively
IR = ingestion rate of fish (IR-F) or invertebrates (IR-Inv) (mg/day)
CL = cooking loss (unitless); assumed to be 0 under the RME scenario

Dermal exposure to surface water

$$DAD = DAevent \times EV \times ED \times EF \times SABW \times AT$$

Where:

DAD = dermally absorbed dose (mg/kg-day)
DA_{event} = absorbed dose per event (mg/cm^2-event); calculated for organics and inorganics per the specific equations in RAGS Part D Table 4.1 based on the chemical concentration in surface water (C_w), fraction absorbed water (FA), permeability coefficient (Kp), lag time per event (T-event), event duration (t-event), time to reach steady-state (t*), ratio of permeability coefficient of a chemical through the stratum corneum of the skin relative to its permeability coefficient across the viable epidermis of the skin (B), and the volumetric conversion factor for water
EV = event frequency (events/day)
SA = skin surface area available for contact (cm^2)

Dermal exposure to sediment and floodplain soil

$$DAD = \frac{DA_{event} \times EV \times ED \times EF \times SA}{BW \times AT}$$

Where:

DA_{event} = absorbed dose per event (mg/cm^2-event); calculated per the specific equation in RAGS Part D Table 4.3 based on the chemical concentration in sediment or soil (C_{sed} or C_{soil}), unit conversion factor (CF), soil or sediment to skin adherence factor (AF), and dermal absorption factor (ABS-d)

Application of these exposure equations results in daily intake for assessing oral exposure or DAD for dermal contact exposure, both of which are expressed in milligrams per kilogram of body weight per day (mg/kg-day). The daily intake is the amount of chemical at the exchange boundary. A fundamental assumption in the estimate of the DAD is that absorption continues long after the exposure has ended (USEPA, 2004b). Thus, the dermally absorbed dose per event (DA_{event}) is the total dose dissolved in the skin at the end of the exposure.

The exposure equations require a chemical concentration or the average concentration contacted over the exposure period (*e.g.*, C_{sed}). In this BHHRA, this is the 95% UCL concentration, where applicable, or maximum detected concentration. The equations also generally require a contact rate (*i.e.*, the amount of contaminated medium contacted per unit time or event), a body weight (*i.e.*, the average body weight over the exposure period), and an averaging time (*i.e.*, the time period over which exposure is averaged).

The AT depends on the type of toxic effect being assessed. When evaluating exposures for potential non-cancer health effects, daily intakes and DADs were calculated by averaging over the period of exposure. This is equivalent to the receptor-specific ED, described below, multiplied by 365 days/year. When evaluating potential cancer risks, daily intakes and DADs were calculated by prorating the total cumulative intake or dose over a lifetime (*i.e.*, lifetime average daily intake). For calculation purposes, this is equal to 70 years multiplied by 365 days/year (25,500 days). This distinction is consistent with the hypothesis that the mechanism of action for each of these health effects endpoints is different. The approach for carcinogens is based on the assumption that a high dose received over a short period of time is equivalent to a corresponding low dose spread over a lifetime.

As noted above, other parameters needed to calculate DA_{event} include chemical-specific parameters, such as the fraction absorbed (FA), dermal permeability coefficient (Kp), and lag time per event (T-event). The Kp reflects movement across the skin to the underlying skin layers and into the bloodstream. The chemical-specific parameter for the ratio of Kp through the stratum corneum relative to its permeability coefficient across the viable epidermis (B) does not appear in the equation for DA_{event} for short exposure times, because DA_{event} is not a function of B at short exposure times. For short exposure times, the amount of chemical absorbed depends only on permeability of the stratum corneum of the skin. The chemical- and exposure scenario-specific factors used in the calculation of DA_{event} for the recreationist/sportsman/angler and outdoor worker are presented in Appendix D.

4.2.2.2 Inhalation Exposure

The following equations are used to estimate inhalation exposure to non-volatile chemicals on respirable particulates released from floodplain soil to outdoor air:

$$EC = \frac{CA \times ET \times EF \times ED}{AT}$$

Where:

EC = exposure concentration (µg/m^3)
CA = chemical concentration in air (µg/m^3)
ET = exposure time (hours/day)

Application of the equation for estimating inhalation exposure (USEPA, 2009a) results in the EC, which is expressed in micrograms per cubic meter (µg/m^3) and is based on the EPC for each COPC in air. The EPCs were modified to account for receptor-specific exposure parameters (*e.g.*, ED, EF, and ET) but do not consider receptor-specific body weight or inhalation rate. This approach is different from that used to evaluate oral and dermal exposures in that the EC, rather than chemical intake, is the metric used to estimate risk. The USEPA believes "the amount of the chemical that reaches the target site is not a simple function of inhalation rate and body weight" but "is affected by factors such as species-specific relationships of exposure concentrations to deposited/delivered doses and physiochemical characteristics of the inhaled contaminant" (USEPA, 2009a). The inhalation toxicity values used to assess both cancer risk and non-cancer hazard are derived from human equivalent concentrations extrapolated from experimental exposures.

The AT in the inhalation exposure equation is expressed in hours. Therefore, for evaluating potential cancer risks, the AT equals 613,200 hours (25,550 days x 24 hours/day). The AT for non-cancer health effects is equivalent to the receptor-specific ED (in years) multiplied by 365 days/year and 24 hours/day. Where the ED is much less than 1 year (*e.g.*, for the construction/utility worker), the AT is calculated as ED (in days) x 24 hours/day (USEPA, 2009a).

4.2.3 Receptor-Specific Exposure Parameters

The exposure parameters used to model human exposure to the COPCs under the RME scenario are described in the following sections and presented in RAGS Part D Tables 4.1.RME to 4.20.RME.

A number of exposure parameter values were modified for use in the CTE evaluations, as presented in RAGS Part D Tables 4.1.CTE to 4.20.CTE. Some of these modified values (*e.g.*, ED) are referenced to USEPA guidance, while others (*e.g.*, EF) are based on professional judgment.

Recreationists/Sportsmen/Anglers

Recreationists/sportsmen/anglers are assumed to be local residents who may wade, fish, or otherwise recreate in the Study Area on a regular basis. Informal angler surveys were conducted by two field personnel during the morning of Wednesday, June 6, 2012, during the morning and afternoon of Monday, September 17, 2012, and during the morning and afternoon of Monday, October 1, 2012. The angler survey confirmed recreational fishing occurs in New Market Pond, in Bound Brook near New Market Pond, and in Spring Lake. The survey respondents claimed to have caught largemouth bass (28/38), sunfish (24/38), crappies (14/38), catfish (12/38), smallmouth bass (10/28), carp (9/38), American eel (4/38), yellow perch (3/38), pickerel (1/38), trout (1/38), and white sucker (1/38). Some survey respondents have also caught turtles (12/38), crayfish (2/28), and frogs (1/38). Of the thirty-eight individuals surveyed, thirty-seven claimed to never keep or eat their catch and twenty-six reported they have seen the Fish Advisory warning signs. The angler survey results are summarized in Appendix F.

The specific equations and exposure parameter values used to model recreationist/sportsmen/angler (adults and adolescents) exposures to surface water, sediment, and floodplain soil are presented in RAGS Part D Tables 4.1, 4.3, 4.5, 4.6, 4.17, 4.18, and 4.19. The specific equations and parameter values used to model angler (adults, adolescents, and children) exposures to fish fillet and clams/crayfish are presented in RAGS Part D Tables 4.15 and 4.16.

The following exposure parameter values were used for adults and adolescents exposed to COPCs in surface water, sediment, and floodplain soil:

- For adults, the USEPA (2002b) recommended ED of 30 years (the 90th percentile time at one residence) for a resident receptor was used. For adolescents, an ED of 12 years was used, given the assumed age range was 7-18 years old.

- An EF of 50 days/year was used, assuming exposure occurs two days per week during the warmer 6 months (approximately 25 weeks) of the year.
- An EV of 1 event per day was assumed.
- An event duration (t-event) (or ET depending on the equation) of 2 hours was used, based on professional judgment.
- The skin SA available for dermal contact was assumed to be 6,200 cm^2 for adults and 5,000 cm^2 for adolescents. These SAs were calculated by assuming exposed areas are limited to the face (1/2 head), forearms (1/2 arms), lower legs (1/2 legs), hands, and feet (USEPA, 2011).
- Soil to skin AFs of 0.07 and 0.2 were used for adults and adolescents, respectively (USEPA, 2002b).
- For both receptors, the sediment to skin AF was assumed to be 0.5. This value was calculated using the body-part specific AFs for "Adults, Clamming" (Table 7-4; USEPA, 2011) and weighting each AF by the percent of the total exposed skin SA each body part comprises (USEPA, 2011).
- For each receptor, IR-Sed and IR-S were considered equal. For adults, IR-Sed and IR-S were assumed to be 100 mg/day (USEPA, 2002b). For adolescents, IR-Sed and IR-S were assumed to be 200 mg/day, which is the USEPA (2002b) recommended soil ingestion rate for a child receptor.
- The FI conservatively assumed to be 1 (*i.e.*, 100 percent ingested).
- Average BWs of 70 kg for an adult (USEPA, 2002b) and 49 kg for an adolescent (USEPA, 2011) were assumed.

The following exposure parameter values were specifically used for anglers (adults, adolescents, and children) exposed to COPCs via ingestion of fish fillets and invertebrates (*i.e.*, shellfish, including clams and crayfish):

- An ED of 6 years was used for children, given the assumed age range was 0-6 years old.

- In evaluating cancer risks for angler adults, the ED of 30 years was based on 6 years at the child's rate of exposure and 24 years at the adult's rate of exposure (USEPA, 1991).[20] Cancer risks calculated for the angler adult are therefore referred to as "combined angler adult/child" cancer risks.
- For all age groups, an EF of 350 days/year was used, as it is the USEPA (2002b) recommended EF for residential exposure.
- The IR-F for an adult was assumed to be 23.2 g/day (Burger, 2002), which is approximately equivalent to one 5.7-ounce serving per week. The IR-Fs for adolescents and children were assumed to be 2/3 and 1/3, respectively, of the adult IR-F (USEPA, 1997c). Exposures to predatory fish fillet and bottom-feeding fish fillet were modeled separately; therefore, separate risks and hazards were estimated and presented in the Risk Characterization.
- The IR-Inv for an adult was assumed to be 1.9 g/day, which is approximately 8.2 percent of the fish fillet ingestion rate (USEPA, 2011). The IR-Invs for adolescents and children were assumed to be 2/3 and 1/3, respectively, of the adult IR-Inv (USEPA, 1997c). Exposures to Asiatic clams and crayfish were evaluated separately; therefore, separate risks and hazards were estimated and presented in the Risk Characterization.
- COPC loss due to preparation or cooking methods was conservatively assumed to be 0, or none.
- The USEPA (2002b) recommended average BW of 15 kg was used for children.

Outdoor Workers

Outdoor workers are assumed to work to maintain, repair, and/or clean culverts, spillways, bridges, and other structures in the Study Area. The specific equations and exposure parameter values used to model outdoor worker (adult) exposures to COPCs in surface water, sediment, and floodplain soil are presented in RAGS Part D Tables 4.2, 4.4, 4.7, and 4.8. The following exposure parameter values were used:

[20] It is recognized that for consistency, the ED for evaluating non-cancer hazards for the resident adult may be changed to 24 years. However, whether 24 or 30 years is used as the ED, the factor is canceled out by the averaging time (which is equivalent to ED*365 days) in the exposure equation, therefore yielding the same non-cancer hazard quotient.

- An ED of 1 year was used, assuming that continued work at a single location is unlikely and that work by the same individual is even less likely.
- An EF of 60 days/year (12 work weeks) was used, assuming exposure occurs five days per week for approximately three months.
- An EV of 1 event per day was used.
- An ET (t-event) of 8 hours was assumed, based on a standard work day.
- The skin SA available for dermal contact was assumed to be 3,300 cm^2, corresponding to the area of the face, forearms, and hands (USEPA, 2002b).
- The soil to skin AF of 0.3 recommended by USEPA (2002b) for construction workers was used.
- The sediment to skin AF was assumed to be 0.5.
- The IR-Sed/IR-S of 330 mg/day recommended by USEPA (2002b) for construction workers was assumed.
- The FI was conservatively assumed to be 1 (*i.e.*, 100 percent ingested).
- An average adult BW of 70 kg was used (USEPA, 2002b).

Residents[21]

The specific equations and exposure parameter values used to model resident (adults and children) exposures to floodplain soil are presented in RAGS Part D Tables 4.9, 4.10 and 4.20. The values for many exposure parameters (including EV, soil ingestion rate, soil AF, and BW) were assumed to be the same as for recreationist/sportsman/angler adults and children, described above. The following differences applied to resident exposures:

- EDs of 30 years for resident adults and 6 years for resident children were used. However, in evaluating cancer risks for resident adults, the ED of 30 years was

[21] While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

based on 6 years at the child's rate of exposure and 24 years at the adult's rate of exposure (USEPA, 1991).[22] Cancer risks calculated for the resident adult are therefore referred to as "combined resident adult/child" cancer risks.

- An EF of 350 days/year was used, assuming 15 days (two weeks) away from the home over the course of a year (USEPA, 1991).
- An ET of 24 hours/day was used, assuming continuous exposure.
- USEPA (2002b) recommended skin SAs of 5,700 cm^2 for adults and 2,800 cm^2 for children were used.

Commercial/Industrial Workers

Commercial/industrial workers are assumed to work primarily outdoors on commercial/industrial properties located within the 100-year floodplain areas included in the Study Area. The specific equations and exposure parameter values used to model commercial/industrial worker (adult) exposures are presented in RAGS Part D Tables 4.11 and 4.12. The values for many exposure parameters (including EV, ET, skin SA, and BW) were assumed to be the same as for outdoor worker exposure to floodplain soil, described above. The following differences applied to commercial/industrial workers:

- An ED of 25 years was used (USEPA, 2002b).
- An EF of 225 days/year for an outdoor worker was used (USEPA, 2002b).
- The USEPA (2002b) recommended soil to skin AF of 0.2 was used.
- The IR-S was assumed to be 100 mg/day (USEPA, 2002b).

Construction/Utility Workers

Construction/utility workers are assumed to perform short-term intrusive work for construction or utility installation, maintenance, or repair within the Study Area. The specific equations and exposure parameter values used to model construction/utility

[22] It is recognized that for consistency, the ED for evaluating non-cancer hazards for the resident adult may be changed to 24 years. However, whether 24 or 30 years is used as the ED, the factor is canceled out by the averaging time (which is equivalent to ED*365 days) in the exposure equation, therefore yielding the same non-cancer hazard quotient.

worker (adult) exposures are presented in RAGS Part D Tables 4.13 and 4.14. The values for all parameters were assumed to be the same as for outdoor worker exposure to floodplain soil, described above.

The only differences in the exposure assessment between the two receptor populations were 1) assumptions regarding the potential mechanisms by which each receptor population may be exposed to COPCs in outdoor air, and 2) it was assumed outdoor workers may be exposed to COPCs in surface water, sediment, and floodplain soil, while construction/utility workers are only exposed to floodplain soils.

Given there are utility lines that traverse Bound Brook and other surface water bodies within the Study Area, the potential for construction/utility workers to be exposed to COPCs in surface water and sediment as well may be evaluated on an EU basis, where applicable. For those EUs, the only difference in the exposure assessment between the construction/utility worker and outdoor worker is the assumed mechanism by which each receptor may be exposed to COPCs in outdoor air.

4.3 Toxicity Assessment

The toxicity assessment, also termed the dose-response assessment, serves to characterize the relationship between the magnitude of exposure and the potential that an adverse health effect will occur. It involves determining whether exposure to a chemical can cause an increase in the incidence of a particular adverse health effect and characterizing the nature and strength of the evidence of causation. The toxicity information is then quantitatively evaluated and the relationship between the dose of the chemical received and the incidence of adverse health effects in the exposed population is evaluated.

The USEPA and other regulatory agencies have performed toxicity assessments for numerous chemicals, and the guidance they provide was used in this BHHRA. These include reference doses (RfD) and reference concentrations (RfC) for the evaluation of noncarcinogenic health effects from chronic and subchronic exposure to chemicals and cancer potency slope factors and unit risk factors for evaluating incremental cancer risk from exposure to chemicals prorated over a lifetime. Sources of toxicological information and toxicity values, in order of preference consistent with USEPA (2003b) guidance, include:

- Tier 1 - Integrated Risk Information System (IRIS) (USEPA, 2012a). IRIS is an internet database that has received internal and external scientific review and contains current information on human health effects that may result from exposure to chemicals in the environment. IRIS was accessed at: http://www.epa.gov/iris
- Tier 2 - Provisional Peer-Reviewed Toxicity Values (PPRTV). PPRTVs were developed by the USEPA Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center and are available as chemical-specific issue papers at the following website: http://hhpprtv.ornl.gov/.
- Tier 3 - Additional USEPA and non-USEPA sources of toxicity information, including but not limited to the California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment's chronic reference exposure levels and cancer potency values, the Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels, and toxicity values published in the USEPA Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

4.3.1 Noncarcinogenic Effects from Chronic Exposure to COPCs

The USEPA (1990) indicates that acceptable exposure levels for chemicals with non-cancer health effects should represent concentration levels to which the human population, including sensitive subpopulations (*e.g.,* the elderly, young children, *etc.*), may be exposed without adverse health effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety. The potential for non-cancer health effects associated with oral and dermal exposures is evaluated by comparing an estimated DI or DAD over a specified time period with a corresponding RfD derived for a similar exposure period. The RfD is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Therefore, the ratio of the DI or DAD to the RfD, termed the HQ and calculated according to the following equations, assumes there is a level of exposure (*i.e.*, the RfD) below which it is unlikely for even sensitive subpopulations to experience adverse health effects.

Noncancer Hazard from Oral Exposure

$$HQ = \frac{DI}{Oral\ RfD}$$

Noncancer Hazard from Dermal Exposure

$$HQ = \frac{DAD}{Absorbed\ RfD}$$

The potential for non-cancer health effects associated with inhalation exposures is evaluated by comparing COPC concentrations in air (*i.e.,* ECs) to RfCs derived for a similar exposure period (USEPA, 2009a). The HQ was estimated by calculating the ratio of the EC to the RfC according to the following equation:

Noncancer Hazard from Inhalation Exposure

$$HQ = \frac{EC}{Inhalation\ RfC}$$

The USEPA has indicated that RfDs and RfCs are based on the assumption that thresholds exist for certain toxic effects and that they often have an uncertainty spanning perhaps an order of magnitude. Chronic RfDs and RfCs were specifically developed to be protective of long-term exposure to a chemical. For outdoor workers and construction/utility workers, for whom exposure is assumed to occur over a one-year period, subchronic RfDs and RfCs were used, where available. For some chemicals, subchronic RfDs and RfCs were estimated from chronic RfDs and RfCs available in IRIS by removing the uncertainty factor applied where a chronic RfD or RfC was extrapolated from a subchronic study. Chronic RfDs and RfCs were used as conservative approximations where subchronic values were not available or could not be estimated.

The RfDs and RfCs for the characterization of potential chronic and subchronic non-cancer health effects via oral and inhalation exposures are presented in RAGS Part D Table 5.1 and Table 5.2 (see Appendix A), respectively, along with the primary target organ, the combined uncertainty and modifying factors used in the derivation of the RfD and RfC, and the source of the RfD and RfC. Generally, order-of-magnitude (*i.e.,* in increments of 10) uncertainty factors reflect the various types of toxicological data (*e.g.,* a laboratory animal study extrapolated to the human condition) used to estimate the RfDs and RfCs. Modifying factors, which can range from greater than zero to 10, reflect qualitative professional judgment regarding scientific uncertainties (*e.g.,* the completeness of the overall database) not covered by the uncertainty factor. Application of the uncertainty and modifying factors is intended to result in RfDs and RfCs that are protective of human health.

RfDs are not available to evaluate dermal exposure. In their absence, oral RfDs were used and adjusted following USEPA (2004b) guidance to reflect absorbed dose. This allows for comparison between exposures estimated as absorbed doses and toxicity values expressed as absorbed doses. The oral-to-dermal adjustment factors and the adjusted RfDs are presented in RAGS Part D Table 5.1.

4.3.2 Carcinogenic Effects from Lifetime Exposure to COPCs

Regardless of the mechanism of effect, risk evaluation methods employed by the USEPA generally derive from the hypothesis that thresholds for cancer induction by carcinogens do not exist and that the dose-response relationship is linear at low doses. Based on this hypothesis, the USEPA has derived estimates of incremental cancer risk from lifetime exposure to potential carcinogens. This is accomplished by establishing the carcinogenic potency of the chemical through critical evaluation of the various test data and fitting dose-response data to a low-dose extrapolation model. The cancer slope factor (CSF), which describes the dose-response relationship at low doses, is expressed as a function of intake [*i.e.*, $(\text{mg/kg-day})^{-1}$].

Incremental lifetime cancer risks from exposure to individual COPCs were estimated according to the following equations for oral and dermal contact exposures, respectively, by multiplying an estimated DI for oral exposures or DAD for dermal contact exposures prorated over 70 years by the corresponding CSFs:

Cancer Risk from Oral Exposure

$$Cancer\ Risk = DI\ \times Oral\ CSF$$

Cancer Risk from Dermal Exposure

$$Cancer\ Risk = DAD\ \times Absorbed\ CSF\ for\ Dermal$$

The resulting risk estimate is expressed as a unitless probability (*e.g.*, 2 x 10^{-5} or 2 in 100,000) of an individual developing cancer. The unitless probability represents the incremental (or increased) lifetime cancer risk associated with the estimated exposure above the background risk of developing cancer. This linear equation is valid only at low risk levels (*i.e.*, below estimated risks of 0.01). According to the USEPA, this approach does not necessarily give a realistic prediction of risk. The true value of the risk at trace ambient concentrations is unknown, and may be as low as zero.

To evaluate inhalation exposures, inhalation unit risk factors (URFs) that relate cancer potency to a chemical concentration in air were used instead of CSFs (USEPA, 2009a). Incremental lifetime cancer risks from inhalation exposure to individual COPCs were estimated according to the following equation, by multiplying the EC by the corresponding inhalation URF:

Cancer Risk from Inhalation Exposure

$$Cancer\ Risk = CA\ \times Inhalation\ URF$$

The oral and dermal CSFs and inhalation URFs for the carcinogenic COPCs are presented in RAGS Part D Table 6.1 and Table 6.2 (see Appendix A), respectively. These toxicity values were used to estimate finite, upper limits of risk at low dose levels administered over a lifetime. For children, the estimated cancer risk reflects the potential risk over a lifetime due to childhood exposure. The USEPA weight-of-evidence classification under the USEPA's 1986 guidelines for carcinogen risk assessment (USEPA, 1986) or cancer guideline description under USEPA's revised carcinogen risk assessment guidelines (USEPA, 2005d, 1999b, 1996a) for carcinogenicity and the source of slope factors or unit risk factors are also presented in RAGS Part D Tables 6.1 and 6.2.

Seven of the PAHs [*i.e.,* benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] are considered probable human carcinogens of varying potency. All of these PAHs were identified as COPCs in one or more data sets evaluated in the BHHRA. Potency factors relative to the carcinogenicity of benzo(a)pyrene, the most studied and most potent of the carcinogenic PAHs, have been developed (USEPA, 1993) and were used to derive the CSFs for the other carcinogenic PAHs.

The USEPA indicates that early-life exposure to carcinogenic chemicals with a mutagenic mode of action can result in a greater contribution to cancers appearing later in life (USEPA, 2005g). To account for this, age dependent adjustment factors (ADAF) were applied to the CSFs and URFs for carcinogenic COPCs with a mutagenic mode of action. The USEPA (2005g) recommends a ten-fold adjustment for exposure during 0 and 2 years of age, a three-fold adjustment for exposures between 2 and 16 years of age, and no adjustment for exposures after turning 16 years of age.

To facilitate the application of ADAFs, DIs and DADs were calculated for each of the following age groups: 0-2 and 2-6 for the child (residents and anglers); 7-16 and 17-18 for the adolescent (recreationists/sportsmen/anglers); 0-2, 2-6, 6-16, and 16-30 for the adult (residents and anglers). For the child receptors, an ADAF of 10 was applied to the cancer toxicity values to evaluate exposure from the ages 0 to 2, and an ADAF of 3 was applied to evaluate exposure from the ages of 2 to 6. For adolescent receptors, an ADAF of 3 was applied to the cancer toxicity values to evaluate exposure from the ages 7 to 16; no adjustment was made to evaluate exposure from the ages of 17 to 18. For the adult receptors, an additional ADAF of 3 was applied to the cancer toxicity values to evaluate exposure from the ages of 6 to 16. No adjustment was made to evaluate exposure from the ages of 16 to 30.

As with RfDs, the USEPA has not derived CSFs to evaluate dermal exposure. In their absence, CSFs for oral exposure were used and adjusted per USEPA guidance to reflect absorbed dose. This allows for risk estimation based on exposures estimated as absorbed doses and slope factors expressed as absorbed doses. The oral-to-dermal adjustment factors and the adjusted CSFs are presented in RAGS Part D Table 6.1.

4.3.3 Noncarcinogenic Effects from Chronic Exposure to Lead

The USEPA has not developed standard estimates representing a dose-response assessment for lead, because a clear threshold for some of the more sensitive effects in humans from exposure to lead has not been identified (ATSDR, 2007). Rather, exposure to lead is typically evaluated in terms of the increase in blood lead (PbB) concentrations following exposure. The United States Department of Health and Human Services' Centers for Disease Control and Prevention and the ATSDR have designated, and the USEPA has adopted, 10 micrograms per deciliter (µg/dL) as a PbB concentration of concern to protect sensitive populations (*e.g.,* neonates, infants, and children). The USEPA's stated goal for lead is that children have no more than a 5 percent probability of exceeding a PbB concentration of 10 µg/dL (USEPA, 2012b).[23] As such, this level is assumed to also provide protection for adults.

For adult workers exposed to lead, the comparison of PbB levels to the health-protective goal is facilitated through use of the USEPA's Adult Lead Methodology (USEPA, 2003a) and Adult Lead Model (ALM). The ALM may also be used to evaluate lead exposures for the adult and adolescent recreationist/sportsman/angler and resident populations, by modifying exposure parameter values (*e.g.,* EF, EF, baseline PbB, *etc.*) input to the model and/or by adding a site-specific fish ingestion pathway, as applicable. With the ALM, concern is for a fetus that may be carried by an exposed pregnant female, with the assumption that the results apply to both exposed females and males. For resident children exposed to lead in floodplain soil, the evaluation is facilitated through use of the USEPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) (USEPA, 2002a, 1994a). The IEUBK model may also be used to evaluate angler child exposure to lead via fish ingestion, by modifying assumptions input to the model regarding dietary intake exposures to lead. With the IEUBK, concern is for an exposed child during ages 0 to 7 years.

[23] Recent evidence suggests that adverse health effects may occur at PbB concentrations of 5 µg/dL or lower (USEPA, 2009b). However, the USEPA Office of Superfund Remediation and Technology Innovation has not yet developed new lead policy to address this recent evidence.

The models were accessed at: www.epa.gov/superfund/programs/lead/products.htm. Exposure to lead is addressed in the RAGS Part D Adult Lead Worksheet for adult exposure and the IEUBK Lead Worksheet for child exposure, provided in Appendix D.

4.3.4 Chemical Mixtures

USEPA guidance was also used to evaluate the overall potential for non-cancer health effects and cancer risks from exposure to multiple chemicals. For the evaluation of non-cancer health effects, USEPA guidance assumes that sub-threshold exposures to several chemicals at the same time could result in an adverse health effect. The sum of the HQs (for individual chemicals, exposure routes, exposure pathways, or potentially-exposed populations),termed the hazard index (HI), is calculated according to the following equation:

$$HI = HQ_1 + HQ_2 + \cdots + HQ_i$$

Where:

HQ_i = hazard quotient for the i^{th} COPC

Generally, HIs are only used in the evaluation of a mixture of chemicals that induce the same effect by the same mechanism of action. In this BHHRA, the HIs of a mixture of chemicals that can have different effects were used as a screening-level approach, as recommended by the USEPA (1989). This approach may over-estimate the likelihood of adverse, non-cancer health effects. Therefore, for HIs that were greater than 1, toxic endpoint-specific HIs were calculated based on the toxicological endpoint (*e.g.,* liver effects) used to derive the non-cancer toxicity value.

For the evaluation of cancer risks, USEPA guidance indicates that the individual risks associated with exposure to each chemical can be summed. This approach, as shown in the following equation, was used in this BHHRA. The approach assumes independence of action by the chemicals involved (*i.e.,* that there are no synergistic or antagonistic chemical interactions and that all chemicals produce the same effect: cancer).

$$Total\ Cancer\ Risk = Cancer\ Risk_1 + Cancer\ Risk_2 + \cdots + Cancer\ Risk_i$$

Where:

Cancer Risk$_i$ = cancer risk for the ith COPC

4.3.5 COPCs without Toxicity Values

Toxicity values (*i.e.,* RfDs, RfCs, cancer slope factors, and unit risk factors) were not available to quantitatively assess the potential for human health risks for all COPCs (*e.g.,* acenaphthylene, benzo[g,h,i]perylene, endrin aldehyde, *etc.*). Possible health implications that may be associated with exposure to these chemicals are described in the Uncertainty Analysis.

4.4 Risk Characterization

Risk characterization involves combining exposure estimates with toxicity information to generate estimates of cancer risk and non-cancer hazard for each human exposure scenario evaluated in the BHHRA. In this section, the cancer risks and non-cancer hazards are presented and discussed. The potential for adverse, non-cancer health effects from exposure to lead is also discussed with respect to the results of the ALM and IEUBK Model for Lead in Children.

4.4.1 Cancer Risks and Non-cancer Hazards

As described in Section 4.3.2, individual cancer risks are expressed as unitless probabilities (*e.g.,* 2 x 10^{-5} or 2 in 100,000) of a person developing cancer. The total individual (*i.e.,* COPC-specific) cancer risks are summed for each exposure pathway and scenario to arrive at an estimate of the potential for cancer risk from cumulative exposure. For known or suspected carcinogens, the NCP established that acceptable exposure levels are generally concentration levels that represent an incremental upper-bound lifetime cancer risk in the range from 10^{-4} (*i.e.,* 1E-04 or 1 in 10,000) to 10^{-6} (*i.e.,* 1E-06 or 1 in 1,000,000) or less (USEPA, 1990). The cancer risks estimated for each exposure scenario were therefore compared to this risk range established by the NCP.

As described in Section 4.3.1, the potential for non-cancer health effects associated with chemical exposure was evaluated by calculating the ratio of an estimated intake or EC over a specified time period with a chemical-specific RfD or RfC derived for a similar exposure period. The RfD or RfC is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. The non-cancer HQ therefore assumes there is a level of exposure below which it is unlikely for even sensitive subpopulations to experience adverse health effects. The total individual HQs were summed for each exposure pathway and scenario to yield HIs representative of the potential for adverse, non-cancer health effects from cumulative exposure. For the non-cancer assessment, exposure scenarios with an HI greater than 1 (*i.e.,* 1E+00) are of potential concern.

The COPC and exposure route-specific incremental lifetime cancer risks and non-cancer hazards associated with potential exposure to the receptors evaluated in this BHHRA are presented in RAGS Part D Tables 7.1.RME to 7.25.RME. Within the series of Tables 7.RME for a given exposure medium/receptor combination, a separate table is presented for each EU. The total cancer risk and total non-cancer HI for the COPCs summed for all exposure pathways and routes for a given receptor/EU are presented in RAGS Part D Tables 9.1.RME to 9.10.RME.

Where the total incremental lifetime cancer risk or total non-cancer HI presented in Table 9.RME is greater than, respectively, the risk range established by the NCP (*i.e.,* 1E-04) or a target HI of 1, the COPCs that are the predominant contributors to the risk or hazard estimates are presented in the corresponding RAGS Part D Table 10.RME. In addition, the CTE scenario is evaluated and Tables 7.CTE, 9.CTE and 10.CTE are presented. Where a total non-cancer HI is greater than 1, toxic endpoint-specific HIs were also calculated and presented in the corresponding RAGS Part D Tables 9 and 10. If a COPC had more than one toxic endpoint (*e.g.,* eyes, nails, immunological), the total HI was accounted for in each toxic endpoint category that applies to the COPC.

Tables 4-5 and 4-6 present summaries of the cancer risks and non-cancer HIs estimated for each receptor population and EU evaluated under, respectively, the RME and CTE scenarios. The cancer risks and non-cancer HIs are presented and discussed by receptor population in the following sections. Emphasis is placed on cancer risks and non-cancer hazards estimated using RME parameters, as evaluation of the RME scenario serves as the determination regarding remedial action.

4.4.1.1 Recreationist/Sportsman – Adult

As shown in Table 4-5, the total cancer risks estimated for current/future adult recreationists/sportsmen under the RME scenario range from 1E-05 to 4E-03, and the total non-cancer HIs range from 3E-01 to 3E+00. The greatest cancer risk was estimated for EU BB3, but cancer risks greater than 1E-04 were also estimated for EUs BB1, BB2, BB4, BB5, and BB6. The only non-cancer HI greater than 1 was estimated for EU BB5. For all EUs with risks/hazards greater than acceptable levels, the potential for adverse health effects was from exposure to Surface Sediment.

RAGS Part D Table 7.1.RME (surface water), Table 7.4.RME (Surface Sediment), and Table 7.7.RME (Surface Soil) present the calculation of cancer risks and non-cancer hazards for each of the exposure pathways and routes evaluated for adult recreationists/sportsmen. As shown in Table 10.1.RME for EUs BB1 through BB6, the predominant contributor to the cancer risk is ingestion and dermal contact exposure to benzidine in Surface Sediment. As shown in Table 10.1.RME for EU BB5, the predominant contributor to the total non-cancer hazard is ingestion and dermal contact exposure to total PCB Aroclors in Surface Sediment.

Use of CTE parameters for adult recreationists/sportsmen results in a cancer risk of 6E-04 at EU BB3 and a non-cancer HI of 1E+00 at EU BB5.

4.4.1.2 Recreationist/Sportsman – Adolescent

As shown in Table 4-5, the total cancer risks estimated for current/future adolescent recreationists/sportsmen range from 5E-06 to 9E-04, and the total non-cancer HIs range from 4E-01 to 5E+00. The greatest cancer risk was estimated for EU BB3, but cancer risks greater than 1E-04 were also estimated for EUs BB1, BB2, BB4, BB5, and BB6. For all EUs with cancer risks greater than 1E-04, the potential for adverse health effects was from exposure to Surface Sediment. Non-cancer HIs greater than 1 were estimated for EU BB5 (from exposure to Surface Sediment and Surface Soil) and EU BB6 (from exposure to Surface Soil).

RAGS Part D Table 7.2.RME (surface water), Table 7.5.RME (Surface Sediment), and Table 7.8.RME (Surface Soil) present the calculation of cancer risks and non-cancer hazards for each of the exposure pathways and routes evaluated for adolescent recreationists/sportsmen. As shown in Table 10.2.RME for EUs BB1 through BB6, the predominant contributor to the cancer risk is ingestion and dermal contact exposure to benzidine in Surface Sediment. As shown in Table 10.2.RME for EUs BB5 and BB6, the predominant contributor to the total non-cancer hazard is ingestion and dermal contact exposure to total PCB Aroclors in Surface Sediment (EU BB5 only) and Surface Soil (EUs BB5 and BB6).

Use of CTE parameters for adolescent recreationists/sportsmen results in a cancer risk of 4E-04 at EU BB3 and a non-cancer HI of 2E+00 at EU BB5.

4.4.1.3 Angler –Adult

The exposure evaluation for the current/future angler adult is effectively the same as that for adult recreationists/sportsmen except that anglers are assumed to also consume fish or shellfish caught within the Study Area. RAGS Part D Table 7.1.RME (surface water), Table 7.4.RME (Surface Sediment), and Table 7.7.RME (Surface Soil) present the calculation of cancer risks and non-cancer hazards for the surface water, sediment, and floodplain soil exposure pathways and routes evaluated for angler adults. These are the same tables referenced above for adult recreationists/sportsmen. As shown in Tables 4-5 and 4-6, the estimated cancer risks and non-cancer HIs from exposure to surface water, Surface Sediment, and Surface Soil within each EU are the same for these two receptor populations.

The additional exposure pathways specific to anglers are ingestion of fish fillet (*i.e.,* predatory fish fillet or bottom-feeding fish fillet) and ingestion of shellfish (*i.e.,* Asiatic clams or crayfish). As indicated in Section 4.2.3, exposures to predatory fish fillet and bottom-feeding fish fillet were modeled separately, and exposures to clams and crayfish were modeled separately. The fish fillet ingestion rate (*e.g.,* 23.2 g/day for an adult angler) was used to estimate cancer risks and non-cancer hazards from consumption of predatory fish fillet, and separately, from consumption of bottom-feeding fish fillet. Similarly, the shellfish ingestion rate (*e.g.,* 1.9 g/day for an adult angler) was used to estimate cancer risks and non-cancer hazards from consumption of Asiatic clams, and separately, from consumption of crayfish. Therefore, it was assumed that all of the fish meals consumed by an angler consist of only fish fillet or shellfish; all of the fish fillet meals consist of only predatory fish fillet or bottom-feeding fish fillet; and all of the shellfish meals consist of only Asiatic clams or crayfish. This approach theoretically bounds the cancer risks and non-cancer hazards for anglers, in that the risks/hazards from eating a combination of fish fillet and shellfish are somewhere between those estimated for each type of fish or shellfish (assuming the fish fillet and shellfish ingestion rates represent RME).

Consumption of Fish Fillet

As shown in Table 4-5, the total cancer risks estimated for combined angler adults/children who consume predatory fish fillet range from 3E-04 to 5E-03, and the total non-cancer HIs for angler adults range from 6E+00 to 1E+02. Use of CTE parameters results in cancer risks between 7E-05 and 1E-03 and non-cancer HIs between 4E+00 and 9E+01.

The total cancer risks for combined angler adults/children who consume bottom-feeding fish fillet range from 3E-03 to 2E-02, and the total non-cancer HIs for angler adults range from 1E+02 to 6E+02. Use of CTE parameters results in cancer risks between 6E-04 and 5E-03 and non-cancer HIs between 8E+01 and 5E+02. For both predatory fish fillet and bottom-feeding fish fillet, the greatest cancer risk and non-cancer HI were estimated for EU BB5, but risks and hazards greater than acceptable levels were estimated for all EUs, including GB and SL.

RAGS Part D Table 7.14.RME (predatory fish fillet) and Table 7.17.RME (bottom-feeding fish fillet) present the calculation of cancer risks and non-cancer hazards for ingestion of fish fillet by angler adults. As shown in Table 10.3.RME for EU BB5, the predominant contributors to the potential for adverse health effects from the fish ingestion pathway are total PCB Aroclors and TCDD TEQ (PCBs).

Total PCB Aroclors in predatory fish fillet result in non-cancer HIs greater than 1 for all EUs and cancer risks greater than 1E-04 for all EUs except BB6. At EU BB6, the total cancer risk greater than 1E-04 is instead attributable to ingestion and dermal contact exposure to benzidine in Surface Sediment. TCDD TEQ (PCBs) in predatory fish fillet result in cancer risks greater than 1E-04 and non-cancer HIs greater than 1 for EUs BB2, BB3, BB4, and BB5.

Total PCB Aroclors in bottom-feeding fish fillet result in non-cancer HIs greater than 1 and cancer risks greater than 1E-04 for all EUs. TCDD TEQ (PCBs) in bottom-feeding fish fillet result in non-cancer HIs greater than 1 and cancer risks greater than 1E-04 for all EUs except GB and BB1. As shown in Table 10.3.RME for EU BB2, a non-cancer HI greater than 1 was also estimated for ingestion exposure to heptachlor epoxide in bottom-feeding fish fillet.

Consumption of Shellfish

As shown in Table 4-5, the total cancer risks estimated for combined angler adults/children who consume Asiatic clams range from 1E-04 to 4E-03. For combined angler adults/children who consume crayfish, the total cancer risks range from 6E-05 to 4E-03. However, cancer risks for the ingestion of shellfish (*i.e.,* Asiatic clams or crayfish) exposure pathway were not greater than 1E-04 at any EU. The total cancer risks greater than 1E-04 are instead attributable to ingestion and dermal contact exposures to benzidine in Surface Sediment, as described above for adult recreationists/sportsmen.

The total non-cancer HIs estimated for angler adults who consume Asiatic clams range from 2E+00 to 7E+00. Use of CTE parameters results in non-cancer HIs between 7E-01 and 4E+00. Of the two data sets used to derive EPCs for Asiatic clams, the greater non-cancer HI (from ingestion of Asiatic clams alone) was estimated for the combined data set for EUs GB, BB1, BB2, BB3, BB4, BB5, and SL.

The total non-cancer HIs estimated for angler adults who consume crayfish range from 2E+00 to 5E+00. Use of CTE parameters results in non-cancer HIs between 2E+00 and 3E+00. Of the two data sets used to derive EPCs for crayfish, the greater non-cancer HI (from ingestion of crayfish alone) was estimated for EU BB6. However, for both Asiatic clams and crayfish, the greatest total non-cancer HI was estimated for EU BB5 because of the contribution of non-cancer hazard from ingestion and dermal contact exposure to total PCB Aroclors in Surface Sediment.

RAGS Part D Table 7.20.RME (Asiatic clams) and Table 7.23.RME (crayfish) present the calculation of cancer risks and non-cancer hazards for ingestion of shellfish by angler adults. As shown in the RAGS Part D Table 10.3.RME for each EU, the predominant contributor to non-cancer hazards from ingestion of either Asiatic clams or shellfish is total PCB Aroclors.

4.4.1.4 Angler – Adolescent

As described above for angler adults, the exposure evaluation for the current/future adolescent anglers is effectively the same as that for adolescent recreationists/sportsmen except that anglers are assumed to also consume fish or shellfish caught within the Study Area. RAGS Part D Table 7.2.RME (surface water), Table 7.5.RME (Surface Sediment), and Table 7.8.RME (Surface Soil) present the calculation of cancer risks and non-cancer hazards for the surface water, sediment, and floodplain soil exposure pathways and routes evaluated for adolescent anglers. These are the same tables referenced above for adolescent recreationists/sportsmen. As shown in Tables 4-5 and 4-6, the estimated cancer risks and non-cancer HIs from exposure to surface water, Surface Sediment, and Surface Soil within each EU are the same for these two receptor populations.

The additional exposure pathways specific to anglers are ingestion of fish fillet (*i.e.,* predatory or bottom-feeding fish fillet) and shellfish (*i.e.,* Asiatic clams or crayfish). For adolescent anglers, a fish fillet ingestion rate of 15.5 g/day was used to estimate cancer risks and non-cancer hazards from consumption of predatory fish fillets, and separately, from consumption of bottom-feeding fish fillets. A shellfish ingestion rate of 1.25 g/day was used to estimate cancer risks and non-cancer hazards from consumption of Asiatic clams, and separately, from consumption of crayfish.

Consumption of Fish Fillet

As shown in Table 4-5, the total cancer risks estimated for adolescent anglers who consume predatory fish fillet range from 1E-04 to 2E-03, and the total non-cancer HIs range from 8E+00 to 1E+02. Use of CTE parameters results in cancer risks between 7E-05 and 9E-04 and non-cancer HIs between 5E+00 and 9E+01.

The total cancer risks for adolescent anglers who consume bottom-feeding fish fillet range from 9E-04 to 7E-03, and the total non-cancer HIs range from 1E+02 to 6E+02. Use of CTE parameters results in cancer risks between 5E-04 and 4E-03 and non-cancer

HIs between 8E+01 and 4E+02. For both predatory fish fillet and bottom-feeding fish fillet, the greatest cancer risk and non-cancer HI were estimated for EU BB5.

RAGS Part D Table 7.15.RME (predatory fish fillet) and Table 7.18.RME (bottom-feeding fish fillet) present the calculation of cancer risks and non-cancer hazards for ingestion of fish fillet by adolescent anglers. As shown in Table 10.4.RME for EU BB5, the predominant contributors to the potential for adverse health effects from the fish ingestion pathway are total PCB Aroclors and TCDD TEQ (PCBs).

Total PCB Aroclors in predatory fish fillet result in non-cancer HIs greater than 1 for all EUs and cancer risks greater than 1E-04 for EUs BB3, BB4, and BB5. At EUs BB1 and BB6, the total cancer risk greater than 1E-04 is instead attributable to ingestion and dermal contact exposure to benzidine in Surface Sediment. TCDD TEQ (PCBs) in predatory fish fillet result in cancer risks greater than 1E-04 for EUs BB3, BB4, and BB5 and non-cancer HIs greater than 1 for EUs BB2, BB3, BB4, and BB5.

Total PCB Aroclors in bottom-feeding fish fillet result in non-cancer HIs greater than 1 and cancer risks greater than 1E-04 for all EUs. TCDD TEQ (PCBs) in bottom-feeding fish fillet result in cancer risks greater than 1E-04 for EUs BB2, BB3, BB4, BB5, and SL and in non-cancer HIs greater than 1 for all EUs except GB and BB1. As shown in Table 10.4.RME for EU BB2, a non-cancer HI greater than 1 was also estimated for ingestion exposure to heptachlor epoxide in bottom-feeding fish fillet.

Consumption of Shellfish

As shown in Table 4-5, the total cancer risks estimated for adolescent anglers who consume Asiatic clams range from 4E-05 to 9E-04. The total cancer risks for adolescent anglers who consume crayfish range from 2E-05 to 9E-04. However, cancer risks for the ingestion of shellfish (*i.e.,* Asiatic clams or crayfish) exposure pathway were not greater than 1E-04 at any EU. The total cancer risks greater than 1E-04 are instead attributable to ingestion and dermal contact exposures to benzidine in Surface Sediment.

The total non-cancer HIs estimated for adolescent anglers who consume Asiatic clams range from 4E+00 to 9E+00. Use of CTE parameters results in non-cancer HIs between 1E+00 and 5E+00. Of the two data sets used to derive EPCs for Asiatic clams, the greater non-cancer HI (from ingestion of Asiatic clams alone) was estimated for the combined data set for EUs GB, BB1, BB2, BB3, BB4, BB5, and SL.

The total non-cancer HIs estimated for adolescent anglers who consume crayfish range from 2E+00 to 7E+00. Use of CTE parameters results in non-cancer HIs between 2E+00 and 3E+00. Of the two data sets used to derive EPCs for crayfish, the greater non-cancer HI (from ingestion of crayfish alone) was estimated for EU BB6. However, for both Asiatic clams and crayfish, the greatest total non-cancer HI was estimated for EU BB5 because of the contribution of non-cancer hazards from ingestion and dermal contact exposures to total PCB Aroclors in Surface Sediment and Surface Soil.

RAGS Part D Table 7.21.RME (Asiatic clams) and Table 7.24.RME (crayfish) present the calculation of cancer risks and non-cancer hazards for ingestion of shellfish by adolescent anglers. As shown in the RAGS Part D Table 10.4.RME for each EU, the predominant contributor to non-cancer hazards from ingestion of either Asiatic clams or shellfish is total PCB Aroclors.

4.4.1.5 Angler – Child

As described in the human health CSEM, it was assumed current/future angler children may be exposed to COPCs originating from the former CDE facility through consumption of locally-caught fish fillet or shellfish in the household, but they are less likely to be exposed to COPCs in surface water, sediment, and floodplain soil within the Study Area.

For angler children, a fish fillet ingestion rate of 7.75 g/day was used to estimate cancer risks and non-cancer hazards from consumption of predatory fish fillets, and separately, from consumption of bottom-feeding fish fillets. A shellfish ingestion rate of 0.625 g/day was used to estimate cancer risks and non-cancer hazards from consumption of Asiatic clams, and separately, from consumption of crayfish.

Consumption of Fish Fillet

As shown in Table 4-5, cancer risks estimated for angler children who consume predatory fish fillet range from 4E-05 to 1E-03, and non-cancer HIs range from 8E+00 to 2E+02.

Use of CTE parameters result in cancer risks between 3E-05 and 8E-04 and non-cancer HIs between 6E+00 and 1E+02.

Cancer risks for angler children who consume bottom-feeding fish fillet range from 6E-04 to 6E-03, and non-cancer HIs range from 2E+02 to 9E+02. Use of CTE parameters result in cancer risks between 5E-04 and 5E-03 and non-cancer HIs between 1E+02 and 7E+02.

For both predatory fish fillet and bottom-feeding fish fillet, the greatest cancer risk and non-cancer HI were estimated for EU BB5, but non-cancer HIs greater than 1 were estimated for all EUs, under both the RME and CTE scenarios. Also under the RME scenario, total cancer risks greater than 1E-04 were estimated for both fish fillet types and all EUs, except for ingestion of predatory fish fillet at EUs GB, BB1, BB6, and SL.

RAGS Part D Table 7.16.RME (predatory fish fillet) and Table 7.19.RME (bottom-feeding fish fillet) present the calculation of cancer risks and non-cancer hazards for the ingestion of fish fillet by angler children. As shown in Table 10.5.RME for EU BB5, the predominant contributors to the potential for adverse health effects are heptachlor epoxide, total PCB Aroclors, and TCDD TEQ (PCBs) in predatory fish fillet and total PCB Aroclors and TCDD TEQ (PCBs) in bottom-feeding fish fillet.

Total PCB Aroclors in predatory fish fillet result in non-cancer HIs greater than 1 for all EUs and cancer risks greater than 1E-04 for EUs BB3, BB4, and BB5. TCDD TEQ (PCBs) in predatory fish fillet result in a cancer risk greater than 1E-04 for EU BB5 and non-cancer HIs greater than 1 for EUs BB2, BB3, BB4, BB5, and BB6.

Total PCB Aroclors in bottom-feeding fish fillet result in non-cancer HIs greater than 1 and cancer risks greater than 1E-04 for all EUs. TCDD TEQ (PCBs) in bottom-feeding fish fillet result in non-cancer HIs greater than 1 and cancer risks greater than 1E-04 for EUs BB2, BB3, BB4, BB5, and SL and a non-cancer HI greater than 1 for EU BB6. As shown in Table 10.5.RME for EUs BB2, BB3, and BB4, non-cancer HIs greater than 1 were also estimated for ingestion exposures to heptachlor epoxide in bottom-feeding fish fillet.

Consumption of Shellfish

As shown in Table 4-5, cancer risks estimated for angler children who consume Asiatic clams range from 2E-06 to 3E-05, which are all less than 1E-04. For angler children who consume crayfish, cancer risks are 2E-05. Therefore, cancer risks estimated for ingestion exposure of angler children to COPCs in shellfish (*i.e.,* Asiatic clams or crayfish) were less than 1E-04 at all EUs.

The total non-cancer HIs estimated for angler children who consume Asiatic clams range from 4E-01 to 6E+00. Of the two data sets used to derive EPCs for Asiatic clams, the greater non-cancer HI was estimated for the combined data set for EUs GB, BB1, BB2, BB3, BB4, BB5, and SL; use of CTE parameters results in a non-cancer HI of 5E+00. The non-cancer HI for EU BB6 is less than 1.

The total non-cancer HIs estimated for angler children who consume crayfish range from 3E+00 to 4E+00, under both the RME and CTE scenarios. Of the two data sets used to derive EPCs for crayfish, the greater non-cancer HI was estimated for the data set for EU BB6.

RAGS Part D Table 7.22.RME (Asiatic clams) and Table 7.25.RME (crayfish) present the calculation of cancer risks and non-cancer hazards for the ingestion of shellfish by angler children. As shown in the RAGS Part D Table 10.5.RME for each EU, the predominant contributors to non-cancer hazards from ingestion of Asiatic clams are total PCB Aroclors and TCDD TEQ (PCBs). The predominant contributor to non-cancer hazards from ingestion of crayfish is total PCB Aroclors.

4.4.1.6 Outdoor Worker – Adult

As shown in Table 4-5, the total cancer risks estimated for current/future outdoor workers range from 6E-07 to 2E-04, and the total non-cancer HIs range from 2E-01 to 2E+00. The only cancer risk greater than 1E-04 was estimated for EU BB3, and the only non-cancer HI greater than 1 was estimated for EU BB5.

RAGS Part D Table 7.3.RME (surface water), Table 7.6.RME (all sediment), and Table 7.9.RME (All Soil) present the calculation of cancer risks and non-cancer hazards for each of the exposure pathways and routes evaluated for the outdoor worker. As shown in

Table 10.6.RME for EU BB3, the predominant contributor to the cancer risk is ingestion exposure to benzidine in All Sediment.

As shown in Table 9.6.RME for EU BB5, the potential for non-cancer hazard at EU BB5 was from exposure to All Sediment (7E-01) and All Soil (9E-01). The greatest individual HIs were estimated for total PCB Aroclors in All Sediment (5E-01) and All Soil (6E-01). However, the non-cancer HIs for all individual COPCs within an exposure medium were less than 1. Therefore, no Table 10.6.RME was presented for EU BB5.

Use of CTE parameters for outdoor workers results in a cancer risk of 6E-05 at EU BB3 and a non-cancer HI of 5E-01 at EU BB5.

4.4.1.7 Resident – Adult

The human health CSEM established that current/future residents (adults and children) may be exposed to floodplain soils (All Soil) within the Study Area. However, the potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures, but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

As shown in Table 4-5, the total cancer risks estimated for combined resident adults/children range from 5E-05 to 6E-04, and the total non-cancer HIs range from 3E-01 to 7E+00. The greatest cancer risk was estimated for exposure to All Soil from EU BB5, while the greatest non-cancer HI was estimated for exposure to All Soil from EU BB6.

RAGS Part D Table 7.10.RME presents the calculation of cancer risks and non-cancer hazards for the resident adult. As shown in Table 10.7.RME for EU BB5, the predominant contributors to the estimated cancer risk are ingestion exposure to dieldrin and total PCB Aroclors in All Soil. As shown in Table 10.7.RME for EU BB6, the potential for non-cancer hazard is from ingestion and dermal contact exposure to total PCB Aroclors.

Use of CTE parameters results in a cancer risk for combined resident adults/children of 5E-05 at EU BB5 and a non-cancer HI for resident adults of 5E+00 at EU BB6.

4.4.1.8 Resident – Child

As shown in Table 4-5, the total cancer risks estimated for current/future resident children range from 4E-05 to 4E-04, and the total non-cancer HIs range from 2E+00 to 6E+01. The greatest cancer risk was estimated for exposure to All Soil from EU BB5, but cancer risks greater than 1E-04 were also estimated for EUs BB3, BB4, and BB6. The greatest non-cancer HI was estimated for exposure to All Soil from EU BB6. Non-cancer HIs greater than 1 were estimated for all EUs except SL, for which floodplain soil data were not available.

RAGS Part D Table 7.11.RME presents the calculation of cancer risks and non-cancer hazards for resident children. As shown in Table 10.8.RME for EU BB6, the potential for non-cancer hazard is from ingestion, inhalation, and dermal contact exposure to total PCB Aroclors in All Soil. Non-cancer HIs greater than 1 were also estimated for exposure to total PCB Aroclors in All Soil at EUs BB3, BB4, and BB5, for ingestion exposure to antimony, iron, and thallium in All Soil at EU BB3, and for ingestion exposure to dieldrin at EU BB5.

Table 9.8.RME for EU BB5 shows the predominant contributors to the cancer risk are dieldrin and total PCB Aroclors. However, no individual (*i.e.*, COPC-specific) cancer risks are greater than 1E-04. As shown in the Table 10.8.RME for EUs BB3, BB4, and BB6, the only COPC with an individual cancer risk greater than 1E-04 is total PCB Aroclors in All Soil at EU BB6.

Use of CTE parameters for resident children results in a cancer risk of 4E-04 at EU BB5, which is the same as under the RME scenario, and a non-cancer HI of 4E+01 at EU BB6.

4.4.1.9 Commercial/Industrial Worker – Adult

It was assumed current/future commercial/industrial workers may be exposed to COPCs in floodplain soil (Surface Soil). As shown in Table 4-5, the total cancer risks estimated for commercial/industrial worker exposures to Surface Soil range from 1E-05 to 1E-04, and the total non-cancer HIs range from 2E-01 to 5E+00. The only EUs for which non-cancer hazards greater than 1 were estimated were for EUs BB5 and BB6.

RAGS Part D Table 7.12.RME presents the calculation of cancer risks and non-cancer hazards for commercial/industrial worker exposure to Surface Soil. As shown in Table 10.9.RME for EU BB5 and EU BB6, the potential for non-cancer hazard is from ingestion and dermal contact exposure to total PCB Aroclors.

Use of CTE parameters for commercial/industrial workers results in a noncancer HI of 3E+00 at EU BB6.

4.4.1.10 Construction/Utility Worker – Adult

It was assumed current/future construction/utility workers may be exposed to COPCs in floodplain soil (All Soil). As shown in Table 4-5, the total cancer risks estimated for construction/utility workers range from 4E-07 to 4E-06, which are all less than 1E-04, and the total non-cancer HIs range from 5E+00 to 8E+00. The greatest non-cancer HI was estimated for EU BB3, but non-cancer HIs greater than 1 were estimated for every EU.

RAGS Part D Table 7.13.RME presents the calculation of cancer risks and non-cancer hazards for construction/utility worker exposure to All Soil. As shown in Table 10.10.RME for every EU, the potential for non-cancer hazard is from inhalation exposure to manganese.

Use of CTE parameters for construction/utility workers results in a noncancer HI of 6E+00 at EU BB3.

4.4.2 Discussion of Cancer Risks and Non-cancer Hazards

As shown in Table 4-5 and presented in each section above, total cancer risks greater than the risk range established by the NCP (*i.e.,* greater than 1E-04) were estimated for the following receptor populations:

- Adult and adolescent recreationists/sportsmen at six of the EUs on Bound Brook (EUs BB1, BB2, BB3, BB4, BB5, and BB6). The cancer risks are attributable to benzidine in Surface Sediment.

- Adult and adolescent anglers at every EU in the Study Area. The cancer risks are predominantly attributable to benzidine in Surface Sediment and total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet.
- Child anglers at every EU in the Study Area. The cancer risks are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet.
- Outdoor workers at EU BB3. The cancer risk is attributable to benzidine in All Sediment.
- Adult and child residents[24] at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The cancer risks are predominantly attributable to total PCB Aroclors in All Soil, but for adult residents at EU BB5, also to dieldrin in All Soil.

Cancer risks estimated for the above receptors at other EUs, for child anglers exposed to shellfish at all EUs in the Study Area, for commercial/industrial workers exposed to Surface Soil at all EUs, and for construction/utility workers exposed to All Soil at all EUs were less than or within the risk range established by the NCP. Cancer risks for adult and adolescent anglers are also less than 1E-04 for the shellfish ingestion pathway at all EUs in the Study Area; however, the total cancer risks for these receptors were greater than 1E-04 at most EUs due to contributions of cancer risk from exposure to COPCs in other environmental media.

The potential for adverse, non-cancer health effects was indicated for:

- Adult recreationists/sportsmen at EU BB5. The hazard is attributable to total PCB Aroclors in Surface Sediment.
- Adolescent recreationists/sportsmen at four EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The hazards are predominantly attributable to total PCB Aroclors in Surface Sediment and Surface Soil.

[24] While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

- Adult and adolescent anglers at every EU in the Study Area, from exposure to fish fillet or shellfish, predominantly, and exposure to Surface Sediment and Surface Soil as described above for recreationists/sportsmen. The hazards from exposure to fish fillet are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet, but at EU BB2, also to heptachlor epoxide in bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors in Asiatic clams or crayfish.
- Child anglers at every EU in the Study Area. The hazards from exposure to fish fillet are attributable to heptachlor epoxide, total PCB Aroclors, and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors and TCDD TEQ (PCBs) in Asiatic clams or total PCB Aroclors in crayfish.
- Outdoor workers at EU BB5. The hazard is attributable to total PCB Aroclors in All Sediment and All Soil.
- Adult residents at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6) and child residents at every EU except SL, for which floodplain soil data were not available. The hazards for the adult resident are attributable to total PCB Aroclors in All Soil, while hazards for the child resident are predominantly attributable to total PCB Aroclors, but at EU BB3, also to antimony, iron, and thallium in All Soil, and at EU BB5, also to dieldrin in All Soil.
- Adult commercial/industrial workers at EUs BB5 and BB6. The hazards are attributable to total PCB Aroclors in Surface Soil.
- Adult construction/utility workers at every EU in the Study Area, from inhalation exposure to manganese in All Soil.

The non-cancer hazards estimated for the above receptors at other EUs were less than 1.

The primary Site-related contaminants are PCBs and chlorinated VOCs. This BHHRA does not indicate a potential for adverse health effects from exposure to chlorinated VOCs but confirms there is a potential for unacceptable cancer risk and non-cancer hazard from exposure to concentrations of total PCB Aroclors in sediment, floodplain soil, fish and shellfish that is relatively wide-spread throughout the Study Area. The non-cancer hazards from exposure to total PCB Aroclors in sediment is limited to EU BB5, but total PCB Aroclors in floodplain soil, fish fillet, or shellfish was the predominant contributor to a non-cancer HI greater than 1 for at least one receptor population at every

EU. When evaluated as TCDD TEQ, PCBs in fish fillet or shellfish was the predominant contributor to an unacceptable cancer risk or non-cancer hazard for at least one receptor population at every EU.

The widespread nature of the potential for adverse health effects to adult anglers exposed to COPCs in bottom-feeding fish fillet, for example, is illustrated in Figure 4-1 (cancer risks) and Figure 4-2 (non-cancer hazards). Elevated risks and hazards associated with PCBs in fish were higher for consumption of bottom-feeding fish fillet than predatory fish fillet at all EUs on Bound Brook. The non-cancer hazards associated with PCBs in shellfish were greater for consumption of crayfish than Asiatic clams at EU BB6 but were greater for consumption of Asiatic clams than crayfish at the other EUs (*i.e.,* the combined data sets for EUs GB, BB1, BB2, BB3, BB4, BB5, and SL).

Benzidine was identified as the predominant contributor to cancer risks estimated for adult and adolescent recreationists/sportsmen/anglers exposed to Surface Sediment at EUs BB1, BB2, BB3, BB4, BB5, and BB6 and for outdoor workers exposed to All Sediment at EU BB3. Benzidine is a manufactured chemical associated with the dye industry (ATSDR, 2001). Most human exposures occur in occupational settings, as benzidine does not appear naturally in the environment. Benzidine was only analyzed for in samples collected during the USEPA's 1997 Ecological Evaluation (USEPA, 1999a). It was detected in Surface Sediment (0-15.24 cm) samples from EUs BB1 through BB6, with EU BB6 being upstream of the former CDE facility, and it was detected in 19/20 samples, at concentrations ranging from 4.6 – 81 J mg/kg. The relatively limited number of samples in which benzidine was analyzed for resulted in small data sets for each EU. Maximum detected concentrations were used as the EPC for benzidine in four of the six Surface Sediment data sets. There is some uncertainty associated with cancer risks based on maximum detected concentrations; however, it is not likely that use of 95% UCL concentrations would have resulted in much lower estimated cancer risks. For example, even the minimum detected concentration (4.6 mg/kg) results in an individual cancer risk of 8E-05 for an adolescent recreationist/sportsman exposed to benzidene in Surface Sediment.

The presence of other chemicals that were demonstrated to be predominant contributors to the unacceptable cancer risks and non-cancer hazards estimated in this BHHRA is not likely attributable to the former CDE facility. These chemicals of concern (COC) are limited to heptachlor epoxide in fish fillet and dieldrin and select metals (*i.e.,* antimony, iron, manganese, and thallium) in floodplain soil. The remainder of this section contains additional observations (*e.g.,* frequency of detection, detected concentrations, or spatial distribution, *etc.*) specific to COCs in select data sets. However, considering the nature of documented historical activities, detected concentrations of these COCs in environmental media throughout the Study Area are not likely attributable to operations at the former CDE facility.

Dieldrin was a predominant contributor to the cancer risk estimated for combined resident adults/children and to the non-cancer hazard estimated for resident children, both exposed to All Soil at EU BB5. As shown in RAGS Part D Table 2.28, dieldrin was detected in 14/24 samples, at concentrations ranging from 0.000043 – 16 J mg/kg, in the All Soil data set for EU BB5. The maximum concentration was detected in SS03 (0-15.24 cm), which was collected from floodplain soil along the banks of Bound Brook, adjacent to the former CDE facility (Foster Wheeler, 2001a). The second highest dieldrin concentration in the All Soil data set for EU BB5 was 0.37 mg/kg. Use of this concentration as the EPC for dieldrin would result in an estimated cancer risk of 9E-06 for the combined resident adult/child and a non-cancer HI of 9E-02 for the resident child under RME scenarios. The observation of 16 mg/kg in SS03 is an outlier in the EU BB5 All Soil data set and likely represents an isolated hotspot. Its inclusion in the risk assessment data set artificially elevates the EPC for dieldrin and over-estimates the potential for adverse health effects from exposure to All Soil at EU BB5.

Heptachlor epoxide was identified as a predominant contributor to non-cancer hazards estimated for anglers (adults, adolescents, and children) who consume bottom-feeding fish fillet from EU BB2. Heptachlor epoxide was also identified as a contributor to non-cancer hazards estimated for angler children who consume bottom-feeding fish fillet from EUs BB3 and BB4 and predatory fish fillet from EU BB5. As shown in RAGS Part D Tables 2.31 and 2.33, heptachlor epoxide was detected in 21/38 predatory fish fillet samples and 21/46 bottom-feeding fish fillet samples. Observations specific to the heptachlor epoxide data set for each EU are included below. However, all of the available data for pesticides in fish fillet are from samples collected for the USEPA's 1997 Ecological Evaluation (USEPA, 1999a), and there is some uncertainty in non-cancer hazards based on fish tissue samples collected fifteen years ago. The data may not represent current conditions or the potential for adverse health effects from current/future exposures. Regardless, pesticide concentrations detected in fish fillet samples throughout the Study Area are not likely attributable to operations at the former CDE facility.

- The EPC for heptachlor epoxide in bottom-feeding fish fillet at EU BB2 was a 95% UCL concentration of 0.070 mg/kg, wet weight. The data set consisted of eight samples, of which only five had detected concentrations, ranging from 0.023 – 0.11 mg/kg, wet weight. Samples were collected from Area 5 (RM4.15) and Area 6 (RM3.52), and the maximum concentration was detected in a carp sample from Area 6.

- The EPC for heptachlor epoxide in bottom-feeding fish fillet at EUs BB3 and BB4 was a 95% UCL concentration of 0.048 mg/kg, wet weight. The data set consisted of six samples, with concentrations ranging from 0.020 – 0.053 mg/kg, wet weight. Samples were collected from Areas 2 (RM5.64) and 3 (RM5.17), and the maximum concentration was detected in a white sucker sample from Area 3.

- The data set for predatory fish fillet at EU BB5 consisted of only three samples; therefore, the maximum detected heptachlor epoxide concentration of 0.040 J mg/kg, wet weight was used as the EPC for this data set. This concentration was detected in a pumpkinseed sunfish sample collected from Area 1 (RM6.54), located adjacent to the former CDE facility. This was also the maximum detected concentration in all predatory fish fillet samples collected throughout the Study Area. Heptachlor epoxide concentrations in the other two predatory fish fillet samples from EU BB5 were 0.00357 J and 0.010 J mg/kg, wet weight. The average concentration was therefore 0.018 mg/kg, wet weight; use of this concentration as the EPC in the exposure assessment results in a non-cancer HI of 7E-01 for an angler child under the RME scenario.

Antimony, iron, and thallium were identified as predominant contributors to the non-cancer hazard estimated for resident children exposed to All Soil at EU BB3. Antimony and thallium are naturally occurring metals that are found at trace levels in the environment. Iron is an essential element used in the body's production of proteins (*e.g.*, hemoglobin and myoglobin) and enzymes. Typical concentrations of antimony in soil are less than 1 mg/kg (ATSDR, 1992a), and concentrations detected in reference area soil samples ranged from 0.99 E – 2.15 J mg/kg. As shown in RAGS Part D Table 2.24, the maximum antimony concentration detected in the All Soil data set for EU BB3 was 792 J mg/kg, which is well outside the expected range of naturally-derived antimony concentrations. The maximum iron concentration (282,000 mg/kg) was also much greater than the range of concentrations in reference area soils (20,200 E – 29,800 J mg/kg). While thallium was not detected in reference area soil samples, typical thallium concentrations in soil are 0.3 – 0.7 mg/kg (ATSDR, 1992b). Thallium concentrations detected in All Soil at EU BB3 ranged from 0.56 – 4.0 mg/kg. The source of elevated metals concentrations in floodplain soil at EU BB3 is not known. Regardless, metals are not contaminants associated with the former CDE facility.

Manganese was identified as the predominant contributor to inhalation hazards estimated for construction/utility workers exposed to All Soil at every EU except SL, for which floodplain soil data were not available. Manganese is a naturally occurring essential element that is found at trace levels in the environment. As shown in the RAGS Part D Table 2s for floodplain soil (All Soil data sets), the maximum manganese concentration detected in floodplain soil at most EUs is within or near the upper end of the range of concentrations detected in reference area soils. Therefore, manganese concentrations observed throughout the Study Area are consistent with background concentrations. In addition, there is some uncertainty associated with use of a chronic toxicity value to evaluate subchronic exposures, such that the actual potential for non-cancer hazard to a construction/utility worker may be less than that indicated by this BHHRA. It should be noted, however, that the maximum manganese concentration detected in floodplain soil at EU BB3 is well outside the range of reference area soil concentrations. As indicated above, the source of elevated metals concentrations at EU BB3 is unknown; regardless, metals are not contaminants associated with the former CDE facility.

4.4.3 Lead Exposure Evaluation

Lead was identified as a COPC in Surface Sediment and All Sediment at EU BB6, in Surface Soil at EUs BB3, BB4, and BB5, and in All Soil at EUs BB3, BB4, BB5, and BB6. Lead was also selected as a COPC in fish and shellfish. It was detected in predatory fish fillet at EUs GB, BB1, BB2, and SL, in bottom-feeding fish fillet at EU SL, and in crayfish tissue at EU BB6 and the combined data set for EUs GB, BB1, BB2, BB3, BB4, BB5, and SL.

The potential for adverse health effects from exposure to lead is evaluated through comparison of predicted PbB concentrations to a health-protective target PbB concentration. As stated in Section 4.3.3, the USEPA's stated goal for lead is that children have no more than a 5 percent probability of exceeding a PbB concentration of 10 µg/dL (USEPA, 2009b). As such, this concentration is assumed to also provide protection for adults.

For adult recreationist/sportsman/angler, outdoor worker, and construction/utility worker exposure to sediment and/or floodplain soil, the USEPA's Adult Lead Methodology (USEPA, 2003b) and Adult Lead Model (ALM) were used to predict PbB concentrations and estimate the probability that target PbB concentrations are exceeded. For resident exposure to floodplain soil, the USEPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) (USEPA, 2007, 2002c, 1994a) was used to predict PbB concentrations in children and estimate the probability that target PbB concentrations are exceeded. In addition, the ALM and IEUBK were used to predict PbB concentrations and estimate the probability that target PbB concentrations are exceeded following exposure to recreationally-caught fish and shellfish which are then consumed by adult and child anglers. The USEPA models were accessed at: www.epa.gov/superfund/programs/lead/products.htm.

4.4.3.1 Adult Lead Modeling - Adult Exposures to Lead

The USEPA ALM estimates PbB concentrations in the two most sensitive receptor populations: women of child-bearing age and an unborn fetus, according to the following equations:

$$PbB_{adult,central} = PbB_{adult,0} + (EPC_{Pb} \text{ x } BKSF \text{ x } IR \text{ x } AF_{Pb} \text{ x } EF \text{ x } 1/AT)$$

and:

$$PbB_{fetal,0.95} = PbB_{adult,central} \text{ x } GSD_{i,adult}^{1.645} \text{ x } R_{fetal/maternal}$$

Where:

$PbB_{adult,central}$ = central estimate of blood lead concentrations (μg/dL) in adults (*i.e.*, women of child-bearing age) that have site exposures to lead in environmental media at concentration, C_{Pb}
$PbB_{adult,0}$ = typical blood lead concentration (μg/dL) in adults (*i.e.*, women of child-bearing age) in the absence of exposures to lead from the site
EPC_{Pb} = lead concentration in the exposure medium (arithmetic average concentration)
BKSF = biokinetic slope factor relating (quasi-steady state) increase in typical adult blood lead concentration to average daily lead uptake (μg/dL blood lead increase per μg/day lead uptake)
AF_{Pb} = absolute gastrointestinal absorption fraction for ingested lead in soil and lead in dust derived from soil (dimensionless)
$GSD_{i,adult}^{1.645}$ = estimated value of the individual geometric standard deviation (dimensionless); the GSD among adults (*i.e.*, women of child-bearing age) that have exposures to similar on-site lead concentrations, but that have non-uniform response (intake, biokinetics) to site lead and non-uniform off-site lead exposures. The exponent, 1.645, is the value of the standard normal deviate used to calculate the 95^{th} percentile from a lognormal distribution of blood lead concentration.
$R_{fetal/maternal}$ = constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration (dimensionless)

The USEPA has indicated that in a commercial/industrial setting, the most sensitive receptor is the fetus of a worker who develops a body burden as a result of non-residential exposure to lead and that this body burden is available to transfer to the fetus several years after exposure has ended.

As noted above, the input parameters needed to estimate PbB concentrations in the adult include a typical, baseline PbB concentration in the absence of site-related exposure, a constant biokinetic slope factor that relates the increase in typical PbB concentration to average daily lead uptake, and a site-specific estimate of average daily uptake of lead through ingestion of the environmental media. The input parameters needed to estimate PbB concentrations in the fetus include a normalized adult PbB concentration and a constant of proportionality between fetal and maternal PbB concentrations. Information on all input parameters is presented in the RAGS D Adult Lead Worksheets provided in Appendix D, Tables D-13 through D-15.

The ALM includes ingestion exposure only. Although other adult lead models exist which incorporate other routes of exposure (*i.e.,* the California Department of Toxic Substances Control's Leadspread model incorporates ingestion, dermal and inhalation routes of exposure), the USEPA has stated that percutaneous absorption of lead is typically not a significant route of exposure and recommends, due to uncertainty surrounding dermal absorption of lead, that uptake from dermal exposure not be quantified.

The geometric mean PbB concentrations ($PbB_{adult,central}$), 95th percentile PbB concentrations among fetuses ($PbB_{fetal,0.95}$), and probabilities that the fetal PbB concentrations are greater than the target PbB (PbB_t) concentration were estimated, presented in the RAGS D ALM Lead Worksheets, and summarized in the following tables.

Outdoor Worker and Construction/Utility Worker

Exposure Medium	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>PbB_t (%)
All Sediment, EU BB6	78	1.8	4.3	0.1
All Soil, EU BB3	1,370	15.5	36.6	71.3
All Soil, EU BB4	129	2.4	5.6	0.4
All Soil, EU BB5	194	3.0	7.2	1.4
All Soil, EU BB6	171	2.8	6.6	1.0

The average lead concentration in All Soil at EU BB3 may pose a risk to outdoor workers and construction/utility workers, but lead concentrations in All Sediment at EU BB6 and in All Soil at EUs BB4, BB5, and BB6 are not likely to pose a risk to them.

Recreationist/Sportsman (Adult)

Exposure Medium	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>PbB_t (%)
Surface Sediment, EU BB6	122	1.3	3.1	0.01
Surface Soil, EU BB3	1,180	4.1	9.8	4.7
Surface Soil, EU BB4	198	1.5	3.6	0.04
Surface Soil, EU BB5	257	1.7	4.0	0.1

Average lead concentrations in Surface Sediment at EU BB6 and in Surface Soil at EUs BB3, BB4, and BB5 are not likely to pose a risk to adult recreationists/sportsmen.

Commercial/Industrial Worker

Exposure Medium	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>PbB_t (%)
Surface Soil, EU BB3	1,180	4.5	10.6	6.2
Surface Soil, EU BB4	198	1.6	3.8	0.05
Surface Soil, EU BB5	257	1.8	4.2	0.1

The average lead concentration in Surface Soil at EU BB3 may pose a risk to commercial/industrial workers, but lead concentrations in Surface Soil at EUs BB4 and BB5 are not likely to pose a risk to them.

Angler (Adult)

Exposure Medium	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability $PbB_{fetal}>PbB_t$ (%)
Predatory Fish Fillet, EUs GB and BB1	0.19	1.2	2.8	0.008
Predatory Fish Fillet, EU BB2	0.13	1.1	2.7	0.005
Predatory Fish Fillet, EU SL	0.20	1.2	2.9	0.008
Bottom-Feeding Fish Fillet, EU SL	0.18	1.2	2.8	0.008
Crayfish, EUs GB, BB1, BB2, BB3, BB4, BB5, and SL	0.79	1.1	2.5	0.003
All Soil, EU BB6	1.5	1.1	2.7	0.005

Lead concentrations in predatory fish fillet at EUs GB, BB1, BB2, and SL, in bottom-feeding fish fillet at EU SL, and in crayfish at all EUs are not likely to pose a risk to adult anglers.

4.4.3.2 IEUBK Modeling - Child Exposures to Lead

The USEPA's IEUBK model was used to evaluate the potential for exposure of resident children to lead in floodplain soil and for exposure of child anglers to lead in fish fillet and shellfish. The focus of the IEUBK model is the prediction of PbB concentrations in young children exposed to lead from several sources and by ingestion and inhalation exposure routes. The model uses four interrelated modules (exposure, uptake, biokinetic, and probability distribution) to mathematically and statistically link environmental lead exposure to PbB concentrations for a population of young children (birth to 84 months of age). A plausible distribution of PbB concentrations, centered on a geometric mean PbB concentration, is predicted and used to estimate the probability that a child's or a population of children's PbB concentrations will exceed the target PbB concentration. The IEUBK model is intended for a residential exposure scenario, as it considers inhalation and ingestion exposures to indoor air and dust that result from tracking soil into the home, as well as dietary and drinking water exposures.

Children ages birth to 7 years old were modeled. Consistent with USEPA guidance, the arithmetic mean lead concentrations in floodplain soil, fish fillet, or crayfish tissue data sets for the applicable EUs were used as the EPCs for lead. IEUBK model defaults for lead in outdoor and indoor air, lead in the diet, lead in drinking water, and maternal lead concentration were used. The multiple source analysis option was selected to model an average household indoor dust concentration. Information on all parameters is presented in the RAGS D IEUBK Lead Worksheets provided in Appendix D, Tables D-16 and D-17.

Predicted lead uptakes and PbB concentration for each age interval are shown in the model output, also in Appendix D. A plausible distribution of PbB concentrations, centered on a geometric mean PbB concentration (PbB_{child}), was predicted and used to estimate the probability that a child's or a population of children's PbB concentrations will exceed the target PbB concentration. This probability density distribution is shown with the model output, and the results are summarized in the following tables.

Resident (Children)

Exposure Medium	EPC_{Pb} (mg/kg)	PbB_{child} (µg/dL)	Probability $PbB>PbB_t$ (%)
All Soil, EU BB3	1,370	11.28	60
All Soil, EU BB4	129	2.08	0.04
All Soil, EU BB5	194	2.68	0.25
All Soil, EU BB6	171	2.47	0.14

Lead concentrations in all floodplain soil at EU BB3 may pose a risk to child residents, whereas lead concentrations in all floodplain soil at EUs BB4, BB5, and BB6 are not likely to pose a risk to them.

Angler (Children)

Exposure Medium	EPC_{Pb} (mg/kg)	PbB_{child} (µg/dL)	Probability $PbB>PbB_t$ (%)
Predatory Fish Fillet, EUs GB and BB1	0.19	2.9	0.46
Predatory Fish Fillet, EU BB2	0.13	2.9	0.40
Predatory Fish Fillet, EU SL	0.20	3.0	0.47
Bottom-Feeding Fish Fillet, EU SL	0.18	2.9	0.45
Crayfish, EUs GB, BB1, BB2, BB3, BB4, BB5, and SL	0.79	2.8	0.34
All Soil, EU BB6	1.5	2.9	0.39

Lead concentrations in predatory fish fillet at EUs GB, BB1, BB2, and SL, in bottom-feeding fish fillet at EU SL, and in crayfish at all EUs are not likely to pose a risk to angler children.

4.4.3.3 Summary of Lead Exposure Modeling

The lead exposure modeling only indicated a potential for elevated PbB (*i.e.*, greater than 10 µg/dL) for adult outdoor workers, adult construction/utility workers, and child residents exposed to All Soil at EU BB3. However, the modeled EPC (1,370 mg/kg representing the arithmetic average concentration) was influenced by three observations (21,300 mg/kg, 9,950 mg/kg, and 3,600 mg/kg) that are statistical outliers in the data set. Therefore, the potential for elevated PbB may be localized to one or more locations within EU BB3.

5 Ecological Risk Assessment

The overall goal of ERA is to evaluate whether adverse effects to ecological receptors (*i.e.*, organisms and their respective habitats) are occurring or may occur as a result of exposure to one or more stressors. In 1996, USEPA Region 2 completed a Screening Level Ecological Risk Assessment at the former CDE facility and concluded that a field investigation to collect additional information was appropriate. In June and August of 1997, USEPA collected surface water, sediment, floodplain soil, and biota samples and used the resulting data in the 1997 Ecological Evaluation (USEPA, 1999a). As described previously, the overall conclusions of the USEPA's 1997 Ecological Evaluation were:

- The structure and function of the stream ecosystem and stream corridor adjacent to and downstream of the former CDE facility are at risk from chemical contamination.
- The benthic community was found to be at risk from exposure to a variety of VOCs and SVOCs, silver, calcium, copper, vanadium, zinc, and dieldrin.
- Fish within the stream were found to be at risk from exposure to selenium and PCBs.

Based on evaluation using maximum detected concentrations and toxicity reference values (TRVs) based on no observable adverse effects levels (NOAELs):

- Insectivorous birds utilizing the stream were found to be at risk from exposure to lead, PCBs, and total endrin.
- Omnivorous birds utilizing the stream were found to be at risk from exposure to lead.
- Piscivorous birds utilizing the stream were found to be at risk from exposure to lead, PCBs, total endrin, total chlordane, and total DDT.
- Omnivorous mammals using the stream were found to be at risk from exposure to methoxychlor, arsenic, mercury, PCBs, and selenium.

- Carnivorous mammals were found to be at risk from exposure to PCBs.

Based on evaluation using mean chemical concentrations and TRVs based on lowest observable adverse effects levels (LOAELs):

- PCBs for omnivorous mammals and piscivorous birds and selenium for omnivorous mammals posed the most significant risks in the food web accumulation models.

During September and October 2008, the USEPA collected fish and invertebrate (Asiatic clam) tissue samples which were analyzed for PCB Aroclors and PCB congeners. These data were used in the 2008/2009 Reassessment (USEPA, 2010a), which focused on only PCBs. The overall conclusions of the 2008/2009 Reassessment were:

- Substantive ecological risk exists to fish and wildlife within Bound Brook resulting from exposure to PCBs.

- Measured concentrations in fish tissue exceed critical body burden data for PCBs at all sampling locations except the reference location (*i.e.*, the reference location identified during the 2008/2009 Reassessment, which is now within the OU4 Study Area).

Based on evaluation using conservative life history parameters (*i.e.*, lowest adult body weight and highest published ingestion rates for food), maximum concentrations for total PCB Aroclors or 95% UCL concentrations for dioxin like PCB congeners, and TRVs based on both NOAELs and LOAELs, unacceptable risk was found for dietary exposure to dioxin like PCB congeners and/or total PCB Aroclors for:

- All wildlife receptors (*i.e.*, piscivorous birds and mammals, insectivorous birds, invertivorous mammals, and omnivorous birds and mammals) utilizing Bound Brook adjacent to and just downstream of the former CDE facility.

- Omnivorous birds and mammals utilizing the reference location, when using NOAEL-based TRVs.

- Piscivorous birds utilizing New Market Pond, Spring Lake, and, when using NOAEL-based TRVs, the reference location.

- Piscivorous mammals utilizing New Market Pond, Spring Lake, and the reference location, when using NOAEL-based and LOAEL-based TRVs.

5.1 Overview

This ERA serves to update and refine the USEPA's 1997 Ecological Evaluation and 2008/2009 Reassessment. Where appropriate, existing information, such as chemical concentration data for environmental media (*i.e.*, sediment, floodplain soil, and biota), available habitat, wildlife species present, were utilized. Additional information on ecological resources within the Study Area and general vicinity was obtained from federal and state agencies, as well as from field observations and data collection in reference locations.

The ERA is consistent with current guidance including:

- The USEPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997a),
- The USEPA' s Guidelines for Ecological Risk Assessment (USEPA, 1998a), and
- The U.S. Army Corps of Engineers' Risk Assessment Handbook Volume II: Environmental Evaluation (USACE, 1996).

Other pertinent guidance documents were also consulted.

The objectives of the ERA are to:

- Identify and characterize existing ecological resources/habitats and resource values (quality/quantity of the resources) within the Study Area.
- Identify biological receptors that may utilize affected habitats within the Study Area.
- Evaluate the potential acute, chronic or bioaccumulation effects resulting from exposure to contamination related to the former CDE facility within the Study Area, currently and in the future in absence of remedial action.

- Provide a basis to evaluate the ecological suitability/impacts of selected remedial alternatives with respect to both short-term and long-term successes.

Since the USEPA's 1997 Ecological Evaluation and 2008/2009 Reassessment were conducted, the Study Area was expanded in August 2011 and additional characterization has been conducted to fill previously identified data gaps and to address the expanded study area. New reference locations (*i.e.*, Ambrose Brook and Lake Nelson) outside the OU4 Study Area were also identified and investigated. Therefore, this ERA includes components of a screening-level risk assessment as well as a baseline risk assessment.

5.2 Problem Formulation

Problem formulation serves to establish the goals, breadth, and focus of the risk assessment (USEPA, 1997a) and is based on the current understanding of the area and information collected during the RI process. Appropriate assessment and measurement endpoints were selected based on the information presented in Section 3 on environmental setting and ecological conceptual site model.

5.2.1 Assessment Endpoints

Assessment endpoints refer to the valued resources that are to be protected from adverse effects caused by exposure to site-related contaminants. For most potential receptors of concern, USEPA (1997a) guidance recommends that protection of the population or community of plants and/or animals is the appropriate level to be provided by any action that may be required. However, because it is difficult to measure effects on populations or communities to verify if the risk predictions are accurate, adverse effects on individual organisms, considered to be representative of the entire population, are usually substituted.

Overall, assessment endpoints are any adverse effects on ecological receptors, (*i.e.*, plant and animal populations and communities) that may be present in or utilize the stream channel or adjacent floodplains within the Study Area. Ultimately, the ecosystem-based assessment endpoint is the protection of the overall structure and function of the stream corridor, including New Market Pond, and Spring Lake, and adjacent floodplains within the Study Area. The overall structure and function of the stream corridor was assessed through the following community-based and population-based assessment endpoints.

Community-Based Assessment Endpoints

- Benthic invertebrate community – long-term maintenance of survival, growth, and reproduction of the benthic invertebrate community.

- Aquatic life community – long-term maintenance of survival, growth, and reproduction of the aquatic life community, and in particular the fish community.

- Terrestrial plant community – long-term maintenance of a healthy and diverse plant community. Plants are primary producers, provide a critical food source, and are the first link in the terrestrial food chain for higher trophic level consumers. In addition, vegetation provides critical habitat for wildlife. This assessment does not evaluate vegetation exposure on a species-by-species basis, only at the community level. Plants that occur in the floodplains are woody and herbaceous species that could serve as a food source and cover for songbirds and small herbivores.

- Soil invertebrate community – long-term maintenance of survival, growth, and reproduction of the soil invertebrate community. Invertebrates present in surface soil within the floodplains provide a source of food for ground gleaning birds and small mammals. They also play a vital role in the ecosystem as primary and secondary decomposers.

Population-Based Assessment Endpoints

- Semi-aquatic bird and mammal populations – long-term maintenance of the survival, growth, and reproduction of semi-aquatic bird and mammal populations within several feeding guilds that inhabit/utilize the stream corridor.

- Terrestrial bird and mammal populations – long-term maintenance of the survival, growth, and reproduction of terrestrial bird and mammal populations within several feeding guilds that inhabit/utilize mainly the floodplains of the stream corridor.

The various bird and mammal species present within the Study Area represent several feeding guilds and play vital roles in the ecosystem, primarily related to the incorporation and transfer of energy from one trophic level to the next and population control. Various species of semi-aquatic herbivorous, insectivorous, omnivorous, and piscivorous birds and mammals and terrestrial herbivorous, insectivorous, omnivorous, and carnivorous birds and mammals have been documented or are likely to be present within the Study Area.

Table 5-1 lists the specific wildlife species selected as representative of these feeding guilds for this risk assessment based on the species life-history information and presence or likely presence within the Study Area. Life history information for these wildlife species is presented in Appendix J. The representative feeding guilds are generally based on the species' major (*i.e.*, greater than 20 percent) year-round food items. However, the feeding guilds for mallard and American robin were selected based on their major food items during the breeding season.

Most of these representative wildlife species were included in the USEPA's 1997 Ecological Evaluation (USEPA, 1999a) and/or 2008/2009 Reassessment (USEPA, 2010a) and are still considered ecologically relevant. Of the species considered in the previous evaluations, the green heron (*Butorides virescens*) and bank swallow (*Riparia riparia*) were not included in this assessment since they are not year-round residents in New Jersey and were not observed during the 2008 Wildlife Species Investigation (Stantec, 2008) or the recent New Jersey Audubon Society surveys (Table 3-1). In addition, the feeding guilds occupied by the green heron and bank swallow are adequately represented by the selected species (*i.e.*, great blue heron and red-winged blackbird). In addition, several terrestrial wildlife species [*i.e.*, American robin, short-tailed shrew (*Blarina brevicauda*), red-tailed hawk, red fox (*Vulpes vulpes*)] were included in this risk assessment which were not in the 2008/2009 Reassessment since additional characterization has been conducted in the floodplains. Red fox was included in food web modeling in the USEPA's 1997 Ecological Evaluation.

While not included in the USEPA's 1997 Ecological Evaluation (USEPA, 1999a) or 2008/2009 Reassessment (USEPA, 2010a), two representative herbivorous semi-aquatic receptors (*i.e.*, wood duck and muskrat) and two representative herbivorous terrestrial wildlife receptors (*i.e.*, mourning dove and Eastern gray squirrel) were included in this risk assessment. These species were selected because they were observed within the Study Area or potential habitat was observed in the Study Area, and their diets are predominantly plant-based.

Potential breeding habitat for wood duck was observed in wooded portions of the Bound Brook floodplain during the 2008 Wildlife Species Investigation (Stantec, 2008) and wood duck were observed upstream of the Study Area in Dismal swamp during the recent New Jersey Audubon Society surveys (Table 3-1). Indirect evidence (tracks) of muskrat was observed within the OU Study Area during the 2008 Wildlife Species Investigation (Stantec, 2008) and a muskrat was observed near the former CDE facility during the June 2011 habitat characterization survey. In addition, as noted in Section 3, large SAV beds able to support muskrat were observed at the upstream (eastern) end of New Market Pond (approximately RM 4.1), in Bound Brook between RM 5.3 – 5.4 and between RM 5.5 and the confluence of Cedar Brook (RM 5.75). Beds of SAV were also present at approximately RM 6.6. Mourning dove may be year-round residents in New Jersey and were observed in the Study Area during the 2008 Wildlife Species Investigation (Stantec, 2008) and the recent New Jersey Audubon Society surveys. Direct and indirect observations of Eastern gray squirrel were made during the 2008 Wildlife Species Investigation (Stantec, 2008) and suitable habitat was found throughout the Study Area.

All of the representative wildlife species were observed directly or indirectly within the Study Area except the wood duck, short-tailed shrew, and the red fox. However, suitable habitat for these species was found within or immediately adjacent to the Study Area during the 2008 Wildlife Species Investigation (Stantec, 2008). Wood duck and red fox have been observed in Dismal Swamp upstream of the Study Area.

While several threatened, endangered, and special concern bird species have been documented within or in the vicinity of the Study Area, they were not specifically selected as representative species. Rather, the species selected for each feeding guild are intended to be representative of all individual species that may be present and occupy that feeding guild, including those species which are considered threatened, endangered, or of special concern. The potential for adverse effects on reptile and amphibian populations was evaluated qualitatively in the uncertainty evaluation due to the general lack of readily available information on metabolism and toxicity in these potential receptors.

5.2.2 Measurement Endpoints

A measurement endpoint is a measurable ecological characteristic that is related to the characteristic chosen as the assessment endpoint. Measurement endpoints can be measures of effect (*i.e.*, changes in community structure) on assessment endpoints, or they can be measures of exposure (*e.g.*, chemical concentrations in soil compared to screening ecotoxicity values), used to infer the potential for adverse effects to communities and the ecosystem in question (USEPA, 1997a).

For the community-based assessment, measured chemical concentrations in abiotic media in conjunction with media screening concentrations protective of receptors in direct contact with those media were used as measurement endpoints for one line of evidence in evaluating the potential for adverse effects to benthic invertebrates, fish, and terrestrial plants and invertebrates. Measured chemical concentrations in biota tissue in comparison to critical body residues provide an additional line of evidence in evaluating the potential for adverse effects to benthic invertebrates and fish. Finally, sediment toxicity testing and estimated chemical concentrations in fish eggs in comparison with critical fish egg residues provide a third line of evidence for benthic invertebrates and fish.

For the population-based assessment, food web accumulation modeling was used in conjunction with toxicity reference values (TRVs; *i.e.*, chronic NOAELs and LOAELs) as measurement endpoints for representative wildlife species within the selected semi-aquatic and terrestrial feeding guilds. Estimated chemical concentrations in bird eggs in comparison with critical avian egg residues provide an additional line of evidence for semi-aquatic birds. A summary of the exposure pathways and assessment and measurement endpoints for the different lines of evidence is provided in Table 5-2.

5.3 Screening-Level Exposure and Effects Analysis

The exposure and effects analysis serves to establish the magnitude of exposure and describe relationships between exposure and potential for adverse effects. Because the OU4 RI served to fill data gaps and investigate the expanded Study Area, a screening-level evaluation was repeated in order to address all the data collected and initially select COPECs. A refinement step was then conducted for the list of COPECs. The refined list of COPECs is then used in the baseline exposure and effects analysis. The risk assessment addresses exposure to surface water on a system-wide basis and exposure to all other media by EU. The EUs were described previously in Section 2.

5.3.1 Screening-Level Evaluation

Part of the exposure and effects analysis is to select COPECs and determine appropriate EPCs to which receptors may be exposed. COPECs were first selected based on comparison of chemical concentrations in abiotic media to ecological screening values (ESV). Several refinement components were then evaluated to further refine the list of COPECs.

All usable data for abiotic media, compiled as discussed in Section 2, were first summarized. Then in a screening-level exposure and effects evaluation, maximum detected concentrations in abiotic media were compared to threshold media concentrations generally considered to be protective of ecological receptors. The HQ approach (*i.e*., ratio of maximum detected concentration to ESV) was used in a screening-level risk calculation step to determine which detected chemicals pose the potential for adverse effects in ecological receptors. Chemicals with an HQ above 1 were selected as COPECs. Chemicals for which ESVs are not available were also selected as COPECs. Chemicals considered essential macronutrients (*i.e*., calcium, magnesium, potassium, and sodium) were eliminated as COPECs. The screening-level evaluation is presented below, by medium.

As noted previously, PCBs in sediment and soil were evaluated as total PCB Aroclors, which, for this risk assessment, is the sum of Aroclor 1242, Aroclor 1254, and Aroclor 1260, when detected. As also noted previously, PCBs in surface water were evaluated as total PCB congeners (as described in Section 2.3). For floodplain soil, 4,4'-dichlorodiphenyldichloroethane (4,4’-DDD), 4,4’-DDE, and 4,4’-DDT were evaluated as total DDx and PAHs were evaluated as total low molecular weight (LMW) and total high molecular weight (HMW) PAHs, where detected. LMW PAHs include: acenaphthylene, acenaphthene, anthracene, fluorene, phenanthrene, and naphthalene. HMW PAHs include: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene).

5.3.1.1 Surface Water

Chemical data from the OU4 RI were summarized together to evaluate surface water on a system-wide basis. Maximum detected chemical concentrations were compared to ESVs protective of aquatic life. ESVs for surface water were selected based on the following hierarchy:

- The lower of the National Recommended Water Quality Criteria for freshwater and the New Jersey Surface Water Quality Criteria for Toxic Substances, freshwater (FW2) criteria for protection of chronic exposure to aquatic life (USEPA, 2013b) (accessed online at: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable),
- The NJDEP Site Remediation Program Ecological Screening Criteria for freshwater (NJDEP, 2009) (accessed online at: http://www.nj.gov/dep/srp/guidance/ecoscreening/),
- Tier II secondary chronic values (Suter and Tsao, 1996).

The frequency of detection, range of detected concentrations, ESV, and screening-level HQ are shown in Table 5-3. HQs for aluminum, manganese, total PCB congeners, TCDD TEQ (PCBs) (for fish, birds, and mammals), and cyanide were greater than 1 and were selected as COPECs. Selected COPECs in surface water are summarized in Table 5-4.

Although not used to select COPECs, surface water quality data collected from investigation of the Woodbrook Site, as described in Section 2, were summarized and compared to ESVs in Table 5-5. As shown in Table 5-5, three SVOCs, total PCB Aroclors, and four metals were detected above ESVs. Of those, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, aluminum, cadmium, lead, and manganese would result in HQs above 1.

5.3.1.2 Porewater

Since surface sediment samples, low resolution sediment cores, and surface water grab samples indicated the presence of VOCs in Bound Brook sediments and surface water that are characteristic of the OU3 groundwater plume (*e.g.*, trichloroethene, cis-1,2-dichloroethene, and vinyl chloride), direct measurements of porewater were made during the OU4 RI to confirm initial lines of evidence of groundwater discharge to Bound

Brook. Porewater samples were collected using passive samplers installed in Bound Brook which were analyzed for VOCs and PCB congeners.

Although the porewater samples were collected from EU BB4, EU BB5, and EU BB6, the VOC data from all 34 samples were summarized together for screening purposes. The PCB congener data from all 19 samples at the 0-10 cm sampling depth, which is representative of the biologically active zone, were summarized together for screening purposes. TCDD TEQ (PCBs) are also presented for fish, birds, and mammals.

Maximum detected chemical concentrations were compared to ESVs protective of aquatic life from the same hierarchy of sources used to screen surface water. The frequency of detection, range of detected concentrations, ESV, and screening-level HQ are shown in Table 5-6. Vinyl chloride and cis-1,2-dichloroethene were the only detected VOCs with an HQ greater than 1 and were selected as a COPECs. HQs for total PCB congeners and TCDD TEQ for fish, birds, and mammals were also greater than 1; therefore, PCBs were also selected as COPECs. Selected COPECs in porewater are summarized in Table 5-4.

5.3.1.3 Sediment

As described previously and in more detail in the RI Report, significant sediment transport is not likely affecting chemical concentrations within sediment of the Study Area. Therefore, only surface sediment (*i.e.*, 0-15 cm) was evaluated in the ERA. Chemical data for the Surface Sediment data set, as described in Section 2.2.3, for each exposure unit were summarized and used to evaluate potential exposure to benthic invertebrates. Maximum detected chemical concentrations in Surface Sediment within each exposure unit were compared to ESVs protective of ecological receptors. ESVs were selected based on the following hierarchy:

- The consensus-based sediment quality guidelines (MacDonald, 2000),
- The USEPA Region 5 Ecological Screening Levels (ESLs) for sediment (USEPA, 2003c) (accessed online at: http://epa.gov/region05/waste/cars/pdfs/ecological-screening-levels-200308.pdf),

- The NJDEP Site Remediation Program Ecological Screening Criteria for sediment (NJDEP, 2009) (accessed online at: http://www.nj.gov/dep/srp/guidance/ecoscreening/).

The frequency of detection, range of detected concentrations, ESVs, and screening-level HQs are presented for each exposure unit in Tables G-1 through G-8 in Appendix G. Selected COPECs are summarized in Table 5-4. The following is a summary of the COPECs selected in one or more exposure units:

- Eleven VOCs, six of which were selected because no ESVs are available.
- Twenty-nine SVOCs, including 15 PAHs. Seven SVOCs were selected because no ESVs are available.
- Thirteen pesticides, one of which was selected because no ESV is available.
- Total PCB Aroclors
- Cyanide and 18 metals, seven of which were selected because no ESVs are available.

Although not used to select COPECs, sediment quality data from the pond at Veterans Memorial Park collected during previous investigations and as part of the OU4 RI, as described in Section 2, were summarized and compared to ESVs in Table 5-7. As shown in Table 5-7, maximum concentrations of all detected chemicals except benzo(b)fluoranthene, di-n-butylphthalate, and di-n-octylphthalate exceed ESVs. Use of maximum detected concentrations would result in HQs greater than 1 for all chemicals except fluorene and arsenic. No ESVs are available for antimony, beryllium, and selenium.

5.3.1.4 Floodplain Soil

Ecological receptors are typically exposed to shallow soil, with 30 cm a typical depth for evaluating exposure to terrestrial plants and soil invertebrates (Suter, 2007). Burrowing mammals may be exposed to deeper soil. However, as the top 30 cm is generally considered the biologically active zone, chemical data for the Surface Soil (*i.e.*, 0 to approximately 30 cm) data set, as described in Section 2.2.4, were summarized and used to evaluate potential exposure to terrestrial plants and invertebrates as well as birds and mammals. Surface Soil data were evaluated for each EU except EU SL, as there are no available floodplain soil data associated with EU SL.

Maximum detected chemical concentrations in Surface Soil within each exposure unit were compared to ESVs protective of ecological receptors. ESVs protective of terrestrial plants, soil invertebrates, birds, and mammals were selected based on the following hierarchy:

- USEPA Ecological Soil Screening Levels (Eco-SSLs) (USEPA, 2013a) (accessed online at: http://www.epa.gov/ecotox/ecossl/),
- USEPA Region 5 Ecological Screening Levels (ESLs) for soil (USEPA, 2003c) (accessed online at: http://epa.gov/region05/waste/cars/pdfs/ecological-screening-levels-200308.pdf), and
- NJDEP Site Remediation Program Ecological Screening Criteria for soil (NJDEP, 2009) (accessed online at: http://www.nj.gov/dep/srp/guidance/ecoscreening/).

The lower of the ESVs protective of terrestrial plants and soil invertebrates, where available, was selected for the screening-level evaluation for terrestrial plants and soil invertebrates. The frequency of detection, range of detected concentrations, ESVs, and screening-level HQs for terrestrial plants and soil invertebrates are presented for each exposure unit in Tables G-9 through G-15 in Appendix G; selected COPECs are summarized in Table 5-4. The following is a summary of the COPECs in Surface Soil for terrestrial plants and soil invertebrates in one or more exposure units:

- Twenty-one VOCs, all selected because no ESVs are available.
- HMW PAHs and 16 SVOCs; all non-PAH SVOCs were selected because no ESVs are available.
- Sixteen pesticides, 13 of which were selected because no ESVs are available.
- Total PCB Aroclors.

- Cyanide, selected because no ESV is available, and 15 metals, one of which was selected because no ESV is available.

The lower of the ESVs protective of birds and mammals, where available, was selected for the screening-level evaluation of higher trophic level organisms. The frequency of detection, range of detected concentrations, ESVs, and screening-level HQs for birds and mammals are presented for each exposure unit in Tables G-16 through G-22 in Appendix G; selected COPECs are summarized in Table 5-4. The following is a summary of the COPECs in Surface Soil for birds and mammals in one or more exposure units:

- Five VOCs, all of which were selected because no ESVs are available.
- HMW PAHs and nine SVOCs; five SVOCs were selected because no ESVs are available.
- Twelve pesticides, five of which were selected because no ESV is available.
- Total PCB Aroclors.
- Cyanide and 14 metals, two of which were selected because no ESVs are available.

5.3.2 COPEC Refinement

Following USEPA guidance (2001a), the lists of COPECs in abiotic media for each exposure unit were refined for consideration in the baseline portion of this risk assessment. The following components were used to refine the lists of COPECs:

- Frequency of detection and concentration.
- Comparison to reference areas.
- Bioaccumulation potential.

For data sets with 20 or more samples, initially-selected COPECs detected in more than 5 percent of the samples were included as refined COPECs. In addition, for initially-selected COPECs with HQs greater than 1, 95% UCL concentrations were compared to

ESVs and refined HQs were calculated. Chemicals with refined HQs greater than 1 were included as refined COPECs. As described previously in Section 4, 95% UCL concentrations were calculated using ProUCL for data sets with less than 70 percent non-detects. For data sets insufficient to calculate 95% UCL concentrations (either too few samples or too few detections), the maximum detected concentrations were used as the EPC. All ProUCL output is presented in Appendix H.

Concentrations of initially-selected metals COPECs were also evaluated in comparison to chemical data from the reference areas. Due to the relatively limited data sets for reference area sediment and floodplain soil, the detected range of metals concentrations for the COPECs in each exposure unit were compared to the detected range of metals concentrations in the reference area. Metals COPECs detected at concentrations exceeding those detected in the reference area were included as refined COPECs. Therefore, those metals detected at concentrations comparable to those detected in the reference area were not considered refined COPECs and were not evaluated further.

The OU4 RI data summaries for reference sediment samples from Ambrose Brook and Lake Nelson and reference soil samples from the Ambrose Brook floodplain are also presented in Appendix B. Thirteen PAHs, two phthalate esters, two pesticides, total PCB Aroclors, 21 metals, and cyanide were detected in the surface sediment samples. Low concentrations of total PCB Aroclors (0.003 to 0.06 mg/kg) were detected in the surface sediment samples. Fourteen PAHs, four pesticides, total PCB Aroclors, 22 metals, and cyanide were detected in the floodplain surface soil samples. Generally low concentrations of total PCB Aroclors (0.03 to 1.6 mg/kg) were detected in the floodplain surface soil samples. Only metals concentrations in reference area sediment and floodplain soil were used to refine the list of COPECs.

Bioaccumulative potential was considered in refinement of the initially-selected COPECs only for evaluation of higher trophic level organisms. Chemicals detected in abiotic media which are considered Important Bioaccumulative Compounds as listed in Table 4-2 of the USEPA's Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment (USEPA, 2000a) and also detected in biotic media from the Study Area (*i.e.*, fish, invertebrate, and mouse tissue) are included as refined COPECs for evaluation in the tissue residue evaluation and in food web modeling. Refined COPECs in Surface Soil which are bioaccumulative were also included as refined

COPECs to estimate concentrations in terrestrial plants for use in food web modeling. Chemicals for which no ESVs are available, while retained as refined COPECs, are evaluated qualitatively in the Uncertainty Analysis.

While all COPECs from the screening level evaluation will be addressed qualitatively in the uncertainty evaluation, refined COPECs will be evaluated further in the risk characterization. The results of the COPEC refinement are summarized below by medium.

5.3.2.1 Surface water

Due to the small surface water data set (fewer than 20 samples) and the lack of surface water data from the reference area, frequency of detection and comparison to reference areas were not used to refine COPECs in surface water. Arsenic, copper, nickel, and zinc, while not originally selected as COPECs, are considered bioaccumulative and were included as refined COPECs for incorporation in food web modeling. The only chemicals detected without ESVs were the essential macronutrients, which are not included as refined COPECs. Refined COPECs for surface water are summarized in Table 5-8.

5.3.2.2 Porewater

Due to the potential for localized impacts, the intent of the porewater sampling program to confirm evidence of groundwater discharge to Bound Brook, and the lack of porewater data from the reference area, the refinement step was not conducted for porewater. COPECs in porewater were retained as refined COPECs, as summarized in Table 5-8.

5.3.2.3 Sediment

COPECs were refined for Surface Sediment in each EU to further evaluate potential exposure to benthic invertebrates. The frequency of detection and range of detected concentrations for Surface Sediment in each exposure unit and reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit in Tables G-23 through G-30 in Appendix G; refined COPECs for sediment are summarized in Table 5-8. The following is a summary of the refined COPECs selected in one or more exposure units:

- Nine VOCs, six of which were selected because no ESVs are available, were retained as refined COPECs. Several VOCs initially selected as COPECs [*i.e.*, 1,1-dichloroehane (EUs BB5 and BB6), methyl tert-butyl ether (EU BB1), and 1,1,2-trichloro-1,2,2-trifluoroethane (EU BB5) were not retained as refined COPECs because they were detected infrequently. Methyl ethyl ketone, which was initially selected as a COPEC only at EUs BB2 and BB6, was not retained as a refined COPEC because the refined HQ was not greater than 1 (BB2) or the EPC did not exceed the screening value (BB6).

- Twenty-eight SVOCs, including 16 PAHs were retained as refined COPECs. Seven SVOCs are without ESVs. Several SVOCs initially selected as COPEC [*i.e.*, acenaphthylene (EU BB5), anthracene (EU BB6), di-n-butylphthalate (EUs BB3 and BB5), , indeno(1,2,3-c,d)pyrene (EUs GB and BB6), naphthalene (EU BB2), and phenanthrene (EU BB6)] were not retained as refined COPECs because the refined HQs were not greater than 1. Benzo(k)fluoranthene for EU BB6 and butyl benzyl phthalate for EU BB4 were not retained as refined COPECs since the EPCs did not exceed ESVs. Carbazole (EU BB6), 2,6-dinitrotoluene (EU BB5), and phenol (EU BB5) were not retained as a refined COPECs because they were detected infrequently.

- Thirteen pesticides, one of which was selected because no ESV is available, were retained as refined COPECs. alpha-BHC for EUs BB3 and BB4 was not retained as a refined COPEC because either the EPC does not exceed the ESV (EU BB3) or the refined HQ was not greater than 1 (EU BB4). Heptachlor for EU BB5 was not retained as refined COPEC because it was detected infrequently.

- Total PCB Aroclors was retained as a refined COPEC for all EUs where initially selected as a COPEC (*i.e.*, EUs BB1, BB2, BB3, BB4, BB5, BB6).

- Cyanide and 15 metals, including seven because no ESVs are available were retained as refined COPECs. The following metals were not retained as refined COPECs for certain EUs because they were either detected at concentrations similar to reference area sediments, had EPCs that did not exceed an ESV, had refined HQs not greater than 1, or were detected infrequently: aluminum (EU BB1), antimony (EUs BB1 and BB6), arsenic (EU BB1), barium (EUs GB and

SL), beryllium (EUs GB, BB2, BB4), cadmium (EU SL), chromium (EUs BB1. BB2, BB3, and BB6), copper (EU SL), iron (EUs GB, BB2, BB3, BB4, BB5, BB6, and SL), lead (EU GB), manganese (EUs BB1, BB5, and BB6), mercury (EUs BB1, BB4, BB5, and BB6), nickel(EUs BB2, BB3, BB4, and BB5), selenium (EU BB6), vanadium (EUs BB4 and SL), and zinc (EUs BB2 and SL).

As indicted in Table 5-8, only bioaccumulative COPECs in sediment that were also detected in aquatic biota tissue (*i.e*., fish and aquatic invertebrates) from the Study Area were included as refined COPECs for tissue residue evaluation and food web modeling for insectivorous and piscivorous semi-aquatic receptors. These include: total PCB Aroclors, two pesticides (*i.e*., total DDx and heptachlor epoxide), and several metals (*i.e*., arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc). In addition, PCBs congeners with dioxin-like toxicity detected in whole body fish and aquatic invertebrate tissue were also evaluated as TCDD TEQ (PCBs) in the tissue residue evaluation and food web modeling.

Because aquatic plant tissue data were not available for use as dietary concentrations in food web modeling for herbivorous semi-aquatic receptors, COPEC concentrations in plants were modeled from sediment concentrations and literature derived bioaccumulation factors, as described in Section 5.4.1.1. Therefore, COPECs in sediment for herbivorous semi-aquatic receptors were selected from the bioaccumulative chemicals detected in Surface Sediment for each EU. PAHs were evaluated as total low molecular weight (LMW) and total high molecular weight (HMW) PAHs. For data sets with 20 or more samples, bioaccumulative COPECs detected in more than 5 percent of the samples and bioaccumulative metals with maximum detected concentrations above the detected range of metals concentrations in the reference area were included as refined COPECs.

The frequency of detection and range of detected concentrations for bioaccumulative chemicals in Surface Sediment in each exposure unit and reference area, and refined COPEC selection are presented in Tables G-31 through G-38 in Appendix G; refined COPECs for sediment are summarized in Table 5-8. The following is a summary of the refined COPECs selected in surface sediment of one or more exposure units for food web modeling for herbivorous semi-aquatic receptors:

- Two VOCs (*i.e.*, 1,4-dichlorobenzene and tetrachloroethene) were retained as refined COPECs for EU BB5.
- Two SVOCs (*i.e.*, 1,2-dichlorobenzne and 1,4-dichlorobenzene) were retained as refined COPECs for EU BB5.
- Total LMW and total HMW PAHs were retained as refined COPECs for every EU.
- Seventeen pesticides were retained as refined COPECs for one or more EUs.
- Total PCB Aroclors were retained as refined COPECs for every EU, except EU SL where it was detected infrequently.
- Ten metals were retained as refined COPECs for one or more EU.

5.3.2.4 Floodplain Soil

COPECs were refined for Surface Soil in each EU except EU SL (where no floodplain soil data were collected) to further evaluate the potential for exposure to terrestrial plants, soil invertebrates, birds, and mammals.

Terrestrial Plants and Soil Invertebrates

The frequency of detection and range of detected concentrations for Surface Soil in each exposure unit and the reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit are presented in Tables G-39 through G-45 in Appendix G; refined COPECs are summarized in Table 5-8. The following is a summary of the refined COPECs for evaluation of terrestrial plants and soil invertebrates selected in one or more exposure units:

- Twelve VOCs were retained as refined COPECs, all because no ESVs are available. Carbon disulfide, carbon tetrachloride, chloroform, chloromethane, cis-1,2-dichloroethene, 1,1-dichloroethane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, ethylbenzene, methyl acetate, methylcyclohexane, and 1,1,1-trichloroethane, which were initially selected as COPECs for EU BB4, were not retained as refined COPECs because they were detected infrequently.

- HMW PAHs and twelve SVOCs were retained as COPECs, the 12 SVOCs because no ESVs are available. Butyl benzyl phthalate for EU BB1; acetophenone, bis(2-chlorethyl-ether, bis-(2-chloroisopropyl) ether, and dimehtylphthalate for EU BB3; and dibenzofuran, 3,3'-dichlorobenzidine, hexachlorobenzene, 4-methylphenol, and 4-nitroaniline for EU BB4 were not retained as refined COPECs because they were detected infrequently. HMW PAHs were not retained as refined COPECs for EUs BB1 and BB4 because the EPC did not exceed the ESV and were not retained as refined COPECs for EU BB3 because the refined HQ was not greater than 1.

- Fourteen pesticides were retained as refined COPECs, including 13 because no ESVs are available. gamma-BHC and total chlordane for EU BB4 were not retained as refined COPECs because EPCs did not exceed the ESVs. Total chlordane for EU BB5 was not retained as a refined COPEC HQ because the EPC did not exceed the ESV. Endrin ketone and heptachlor for EU BB4 were not retained as refined COPECs because they were detected infrequently.

- Total PCB Aroclors was retained as a refined COPEC for EU BB6. However, total PCB Aroclors was not retained as a refined COPEC for EUs BB4 and BB5 because the EPC did not exceed the ESV (EU BB4) or the refined HQ was not greater than 1 (EU BB5).

- Cyanide and 13 metals were retained as refined COPECs, including one because no ESV is available. The following metals were not retained as refined COPECs for certain EUs because they were either detected at concentrations similar to reference area sediments, had EPCs that did not exceed an ESV, or had refined HQs not greater than 1: arsenic (EUs BB3, BB4, and BB5), barium (EU BB4), chromium (EUs BB2 and BB6), cobalt (EUs GB, BB1, BB3, BB4, BB5), copper (EUs GB and BB1), iron (EUs BB2 and BB6), lead (EU GB and BB1), manganese (EUs GB, BB2, BB3, BB5, and BB6), nickel(EUs BB4 and BB5), vanadium (EUs BB2, BB3 and BB6), and zinc (EUs GB and BB1).

Birds and Mammals

The frequency of detection and range of detected concentrations for Surface Soil in each exposure unit and the reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit are presented in Tables G-46 through G-52 in Appendix G; refined COPECs are summarized in Table 5-8 . The following is a summary of the refined COPECs for evaluation of birds and mammals selected in one or more exposure units:

- Three VOCs were retained as refined COPECs, all because no ESVs are available. cis-1,2-Dichloroethene, methyl acetate, and methylcyclohexane for EU BB4 were not retained as refined COPECs because they were detected infrequently.

- HMW PAHs and nine SVOCs were retained as refined COPECs, including five because no ESVs are available. Biphenyl and dibenzofuran for EU BB4 were not retained as a refined COPEC because they were detected infrequently.

- All 12 pesticides initially selected as COPECs were retained as refined COPECs, including five because no ESVs are available. However, beta-BHC, endrin ketone, and heptachlor for EU BB4 were not retained as refined COPECs because they were detected infrequently. Endrin aldehyde for EU BB4 was not retained as a refined COPEC because the refined HQ was not greater than 1.

- Total PCB Aroclors was retained as a refined COPEC for all EUs.

- Cyanide and 13 metals were retained as refined COPECs, including two because no ESVs are available. The following metals were not retained as refined COPECs for certain EUs because they were either detected at concentrations similar to reference area sediments, had EPCs that did not exceed an ESV, had refined HQs not greater than 1, or were detected infrequently: antimony (EU BB1), cadmium (EU BB2), chromium (EU BB1), copper (EUs GB and BB1), iron (EUs BB2 and BB6), lead (EU GB, BB2, and BB6), mercury (EUs BB2 and BB6), nickel (EU BB3), thallium (EUs BB4 and BB5), vanadium (EUs BB2 and BB6), and zinc (EUs BB1 and BB6). In addition, cyanide for EU BB3 was not retained as a refined COPEC because the EPC did not exceed the ESV.

As indicted in Table 5-8, bioaccumulative COPECs in Surface Soil that were also detected in terrestrial biota tissue (*i.e.*, mouse tissue) were included as refined COPECs for food web modeling. These include: Total PCB Aroclors, dieldrin, and total DDx. In addition, while not detected in soil at EU BB4, heptachlor epoxide was retained as a refined COPEC for EU BB4 since it was detected in mouse tissue. In addition, all refined COPECs that are bioaccumulative for terrestrial herbivorous receptors, via uptake into terrestrial plants were included in the food web modeling, as described further in the following section. These include: HMW PAHs, aldrin, beta-BHC, gamma-BHC, total chlordane, dieldrin, total DDx, beta-endosulfan, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, methoxychlor, total PCB Aroclors, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

5.4 Baseline Exposure and Effects Analysis

The baseline exposure and effects analysis evaluates exposure to ecological receptors and identifies measures of toxicity used to characterize the potential for adverse effects for the measurement endpoints. As summarized in Table 5-2, there are multiple lines of evidence for many of the measurement endpoints. The baseline exposure and effects analysis includes the methodology for estimating EPCs for COPEC in the various exposure media. The approach for evaluating exposure and effects for the multiple lines of evidence (*e.g.*, toxicity testing, tissue residue evaluation, and food web modeling) is then discussed.

5.4.1 Exposure Point Concentrations

The COPEC concentrations in the exposure media at the point of exposure (*i.e.*, EPCs) were estimated either system-wide (*e.g.*, surface water) or by exposure unit. The evaluation of measurement endpoints relies on EPCs in surface water, porewater, surface sediment, floodplain soil, and biota to assess:

- direct exposures to primary and secondary trophic level receptors (*e.g.*, aquatic invertebrates, fish, terrestrial plants, and soil invertebrates) which were evaluated via a direct comparison of EPCs to ecological benchmarks in the exposure medium protective of exposure of these organisms;
- bioaccumulation into tissues of secondary trophic level organisms, and
- food-web transfer of bioaccumulative COPECs to higher trophic level organisms, in which EPCs for abiotic and biotic exposure media were used in comparison to critical body residues and as inputs to food web exposure models.

EPCs were calculated for the refined COPECs using the risk assessment data sets described in Section 2. The lower of the maximum detected concentration or the 95% UCL concentration was used as the EPC. As described previously in Section 4, 95% UCL concentrations were calculated using ProUCL for data sets with less than 70 percent non-detects. For data sets insufficient to calculate 95% UCL concentrations (either too few samples or too few detections), the maximum detected concentrations were used as the EPC. All ProUCL output is presented in Appendix H.

EPCs in surface water were estimated on a system-wide basis and were used in evaluating direct exposures to primary and secondary trophic level receptors and as input to food web modeling for higher trophic level organisms. EPCs in surface water are summarized in Table 5-9.

EPCs in Surface Sediment and Surface Soil were estimated for each exposure unit, with the exception of EU SL, for which no floodplain soil data are available. EPCs in Surface Sediment and Surface Soil were used in evaluating direct exposures to primary and secondary trophic level receptors and as input to food web modeling for higher trophic level organisms. EPCs in Surface Sediment and Surface Soil used in evaluating direct exposures to primary and secondary trophic level receptors were presented in Appendix G as part of the COPEC refinement step. EPCs for Surface Sediment and Surface Soil used in food web modeling are summarized by exposure unit in Tables 5-10 through 5-17.

As described in Section 2, available tissue data used in this risk assessment include: whole body fish, crayfish, Asiatic clams, and mice from USEPA's 1997 Ecological Evaluation and 2008/2009 Reassessment. Whole body fish tissue data, for predatory and bottom-feeding fish, are summarized in Table 5-18, crayfish tissue data are summarized in Table 5-19, Asiatic clam tissue data are summarized in Table 5-20, and mouse tissue data are summarized in Table 5-21. Only whole body fish, crayfish, and Asiatic clam data were used in the tissue residue evaluation. Data for all these biota types were used as input to food-web modeling. Because biota data were more limited geographically within the Study Area, EPCs in biota were estimated based on data combined for multiple exposure units.

As described previously in Section 4, a statistical evaluation of the biota data, using ANCOVA, was conducted to evaluate temporal and spatial patterns in total PCB concentrations and to assist in determining whether data collected at different stations throughout the Study Area were statistically significantly different or not. The results of these evaluations is presented in Appendix E.

For whole body fish, the ANCOVA demonstrated there were no statistical differences between total PCB concentrations in 1997 and those in 2008 and that total PCB concentrations in bottom-feeding fish (*i.e.*, carp, white sucker, and brown bullhead catfish) were higher than corresponding concentrations in predatory fish (*i.e.*, pumpkinseed and bluegill sunfish). Based on these evaluations, the following approach was used to group the whole body fish tissue data and calculate EPCs:

- Data from the 1997 and 2008 sampling events were combined.
- Data for bottom-dwelling fish and predatory fish were evaluated separately.
- Data for sampling Locations A3, A4, and A5 were combined and applied to EU GB, EU BB1, EU BB2, and EU BB3.
- Data for sampling Location A2 was applied to EU BB4.
- Data for sampling Locations A1 and S3 were combined and applied to EU BB5.
- Data for sampling Location A9 was applied to EU BB6.
- Data from Spring Lake were applied to EU SL.

For Asiatic clams, the following approach was used to group the data from different stations (as only one species was collected, and data were only available from 2008) and calculate EPCs:

- Data for sampling Locations A2, A3, A4, and A5 were combined and applied to EU GB, EU BB1, EU BB2, EU BB3, EU BB4, and EU BB5. The combined data from these locations was also used as a surrogate for EU SL.
- Data for sampling Location A1 was applied to EU BB6.

For crayfish, the following approach was used to group the data from different stations (as only one species was collected, and data were only available from 1997) and calculate EPCs:

- Data for sampling Locations A1, A2, A3, A4, and A5 were combined and applied to EU GB, EU BB1, EU BB2, EU BB3, EU BB4, and EU BB5. The combined data from these locations was also used as a surrogate for EU SL.

- Data for sampling Location A9 was applied to EU BB6.

Mouse data were combined into the following data sets and applied to the exposure units in the following manner:

- Data for sampling Locations T3 was applied to EU GB, EU BB1, EU BB2, and EU BB3.

- Data for sampling Locations T2 and T4 were combined and applied to EU BB4.

- Data for sampling Locations T1 was applied to EU BB5 and EU BB6.

As described in Section 2, soil bioaccumulation tests for PCB congeners were conducted with *E. fetida* for three floodplain locations within the Study Area along Bound Brook (on the south bank near RM3.15, on the north bank near RM5.7, and on the south bank near RM5.8). Site-specific soil-to-earthworm bioaccumulation factors (BAF) were calculated for each sample by dividing the total PCB concentrations in earthworm tissue (wet weight) by the total PCB concentrations in Surface Soil (dry weight). Total PCB concentrations in soil and earthworm tissue and the calculated site-specific soil-to-earthworm BAF are presented in Table 5-22. An average BAF for the three Bound Brook locations was used to estimate earthworm concentrations at each EU as described below.

The EPC for total PCBs in earthworms were estimated for each EU by multiplying the Surface Soil EPC by the site-specific soil-to-earthworm BAF as follows:

$$C_{earthworm} = Cs \times BAF$$

Where:

$C_{earthworm}$ = Total PCBs concentration in earthworm (mg/kg, wet weight)
Cs = Soil concentration (mg/kg, dry weight)
BAF = Bioaccumulation factor from soil to food source (unitless)

To evaluate dietary exposure for semi-aquatic and terrestrial herbivorous receptors, EPCs in plant tissue were also estimated. EPCs in plant tissue were estimated based on literature-derived soil-to-plant BAFs. BAFs for aboveground plant portions were used to estimate concentrations in foliage and seeds for evaluation of dietary exposure to semi-aquatic herbivorous birds (*i.e.*, wood duck) and terrestrial herbivorous birds and mammals (*i.e.*, mourning dove and eastern gray squirrel), respectively. BAFs for root matter were used to estimate concentrations in roots for evaluation of dietary exposure to semi-aquatic herbivorous mammals (*i.e.*, muskrat). Resulting dry weight concentrations in plants were then converted to wet weight based on:

- 87 percent moisture in aquatic macrophytes (USEPA, 1993b) to model the concentration in aquatic plants consumed by the wood duck.
- 87 percent moisture in root vegetables (USEPA, 2005e) to model the concentration in roots of aquatic vegetation consumed by muskrat.
- 9.3 percent moisture in seeds (USEPA, 1993b) to model the concentration in seeds consumed by terrestrial herbivores.

The BAFs selected were derived from default uptake models or other literature values, as shown in Table 5-23. The refined COPEC concentrations in plants were estimated for each EU by multiplying the Surface Sediment or Surface Soil EPC by the corresponding sediment-to-plant or soil-to-plant BAF:

$$C_{plant} = Cs \times BAF$$

Where:

C_{plant} = COPEC concentration in plant tissue (mg/kg, dry weight)
Cs = Surface sediment or Surface Soil concentration (mg/kg, dry weight)
BAF = Bioaccumulation factor from soil to food source (unitless)

EPCs for all biotic media are also summarized by exposure unit in Tables 5-10 through 5-17.

5.4.2 Toxicity Testing

The results of the acute and chronic whole sediment toxicity tests on *H. azteca* and *Chironomus tentans* conducted during the OU4 RI were used as another line of evidence in assessing the potential for adverse effects to benthic invertebrates. Survival, growth, and reproduction results for locations within Bound Brook and New Market Pond were compared to results for reference locations.

5.4.3 Tissue Residue Evaluation

The residue-based evaluation provides additional lines of evidence in assessing the potential for adverse effects to benthic invertebrates, fish, and birds. The conceptual basis of evaluating tissue residues is that measures of internal exposure are theoretically more predictive of toxic effects than a measure of external dose (McCarty and Mackay, 1993). The tissue residue evaluation was limited to bioaccumulative chemicals detected in fish and invertebrate tissue since this approach is most relevant to chemicals accumulated by aquatic biota via dietary and direct contact exposures (Suter, 2007).

Whole Body Tissue Residues

Measured concentrations in fish and invertebrate tissue were compared to critical body residues (CBRs) derived from data retrieved from the U.S. Army Corps of Engineers (USACE)/USEPA Environmental Residue-Effects Database (ERED) (http://el.erdc.usace.army.mil/ered/). For each COPEC, CBR data were retrieved for mortality (survival), growth, and reproduction effects from whole body measures from studies on freshwater species that spend their entire lives in freshwater; studies of anadromous[25] fish species were not included. The majority of the freshwater species for which data were retrieved could occur in freshwater systems like the Bound Brook system and are, therefore, considered ecologically relevant. From these data CBRs were selected as the highest NOAEL, if available, and the lowest LOAEL, if available. If no NOAEL was available, the selected LOAEL value was divided by 10 and if no LOAEL was available, the selected NOAEL value was multiplied by 10. If the highest NOAEL

[25] Anadromous fish species migrate up rivers from the sea to breed in fresh water.

was higher than the lowest LOAEL, then the selected LOAEL value divided by 10 was used as the NOAEL value. The selected invertebrate and fish tissue CBRs are shown in Tables 5-24 and 5-25, respectively. The whole body residue data retrieved from the ERED database are presented in Appendix I.

Egg Residues

The residue-based evaluation also included comparison of estimated fish and avian egg residues with CBRs for fish and avian eggs. Fish egg residues were estimated for the PCB congeners based on biomagnification factors (BMFs) for the ratio of egg concentration to maternal whole body concentration reported in Cooke et al. (2003). Estimated fish egg concentrations were compared to egg CBRs from Steevens et al. (2005).

Avian egg residues were estimated using BMFs for PCB congeners and several organochlorine pesticides based on a study of herring gull eggs conducted by Braune and Norstrom (1989) and also for PCB congers based on a study of osprey eggs conducted by Henny et al. (2003). For PCBs congeners, BMFs for osprey eggs from Henny et al. (2003) were also used since, unlike herring gulls, osprey are migratory and the osprey studied consumed freshwater fish species. The representative piscivorous avian species selected for this assessment (*i.e*., great blue heron and belted kingfisher), while potential year-round residents, will migrate when ice cover precludes feeding. Although, the potential for exposures to contaminated fish elsewhere adds to the uncertainty of the BMFs from Henny et al., 2003, they were included to evaluate the potential range of bioaccumulated PCBs in avian eggs. Estimated avian egg concentrations were compared to CBRs retrieved from the ERED database. Preference was given to data from studies on piscivorous species. LOAEL and NOAEL values were selected from retrieved data as described above for fish and invertebrate whole body tissue CBRs. Fish egg and avian egg CBRs are summarized in Tables 5-26 and 5-27, respectively. The egg residue data retrieved from the ERED database are presented in Appendix I.

5.4.4 Food Web Modeling Exposure Estimates

For the population-based assessment, intakes of bioaccumulative COPECs (in the form of a dose, in mg COPEC per kg body weight per day) based on total exposure from incidental ingestion of sediment/soil during feeding/foraging, nesting/burrowing, and/or preening activities, ingestion of surface water for drinking, and ingestion of dietary/prey items of each representative wildlife species were estimated. The estimated intakes were then compared to toxicological criteria for each COPEC in the risk characterization section. While exposure via incidental ingestion of sediment/soil is likely greatest for burrowing wildlife, this route of exposure is considered minimal compared to dietary exposure. For many species (*e.g.*, red-tailed hawk), the amount of soil incidentally ingested during feeding or preening is considered negligible.

The following equation (modified from USEPA, 1993c) was used to estimate COPEC intakes through dietary intake, including incidental ingestion of soil/sediment:

$$Intake_{total} = \frac{[[\Sigma(C_{diet}*IR_f*PF_i)]+(C_s*IR_s)+(C_w*IR_w)]*AUF}{BW}$$

Where:

$Intake_{total}$ = Total intake (mg/kg body weight-day)
C_{diet} = COPEC concentration in dietary food type (mg/kg, wet weight)
IR_f = Food ingestion rate (kg/day, wet weight)
PF_i = Proportion of i^{th} food type in the diet (%)
C_s = Sediment/soil concentration (mg/kg, dry weight)
IR_s = Sediment/soil ingestion rate (kg/day, dry weight)
C_w = Surface water concentration (mg/L)
IR_w = Surface water ingestion rate (L/day)
BW = Body weight (kg)
AUF = Area use factor (proportion of species' lifetime spent in area) (unitless)

5.4.4.1 Exposure Parameters

Receptor dietary consumption was categorized into plants, invertebrates, fish, or prey (*i.e.*, small mammals) items. The food intake rates, proportion of soil in the diet, proportion of dietary items in diet, and other necessary exposure parameters (*e.g.*, body weight) used to estimate COPEC intakes for the representative wildlife receptor species were derived from literature sources as described in Appendix J. These exposure parameters are shown in Table 5-28. The home ranges were evaluated in relation to the area of each EU. Area use factors were calculated by dividing the exposure unit area by the home range size, as shown in Table 5-29. Based on the receptor home ranges and the EU areas, area use factors were applied to the food web modeling for the mallard, red-tailed hawk, mourning dove, and red fox.

5.4.4.2 Toxicity Reference Values

USEPA (2007g) defines wildlife TRV as a dose (based on laboratory toxicological investigations) above which a particular ecologically relevant effect may be expected to occur in an organism following chronic dietary exposure and below which it is reasonably expected that such effects will not occur. Both low (NOAEL) and high (LOAEL) TRVs were identified for each COPEC for birds and mammals to bracket a threshold effect level. The NOAEL-based TRV represents a conservative dose level at or below which adverse effects are unlikely to occur. Conversely, the LOAEL-based TRV is a less conservative estimator of potential adverse effects, representing a dose level at which adverse effects may occur. In the absence of either a NOAEL or LOAEL, the missing value was obtained by extrapolating from the existing value by a factor of 10. The following literature sources were reviewed for the selection of TRVs for upper trophic level wildlife (*i.e.*, birds and mammals):

- USEPA EcoSSLs (accessed online at: http://www.epa.gov/ecotox/ecossl/)
- Toxicological studies cited in Sample et al. (1996)
- USEPA Region 6 Screening-Level Ecological Risk Assessment Protocol (USEPA, 1999c)
- Other primary literature sources

When reviewing the toxicological literature and selecting the most appropriate study for TRV development, several factors were considered:

- Taxonomic relationship between the test animal and the indicator species.
- Use of laboratory animals or domesticated species, with preference for wildlife species.
- Toxicological studies where the chemical was administered through diet were preferred over studies using other dosing methods, such as oral gavage or intraperitoneal injection.

- Ecological relevance of the study endpoints. Studies with toxicity endpoints such as reproduction, growth, behavior and developmental endpoints were targeted. Sensitive endpoints such as reproductive or developmental toxicity were preferentially selected because they are closely related to the selected assessment endpoints.

- Long-term studies representing chronic exposure were preferentially selected over short-term, acute studies.

The selected wildlife TRVs for birds and mammals are presented in Tables 5-30 and 5-31, respectively. As mink are highly sensitive to PCB exposure, separate TRVs for total PCB Aroclors were identified: one for piscivorous mammals, based on toxicity in mink, and another for non-piscivorous mammals, based on toxicity in rats and other non-piscivorous mammals.

5.5 Risk Characterization

Risk characterization is the final phase of risk assessment in which the likelihood of adverse effects is evaluated by combining the analyses of exposure and effects. In this phase the likelihood of adverse ecological effects occurring is estimated. Major uncertainties, assumptions, and strengths and limitations, of the assessment are summarized in Section 6.

Risk characterization consists of estimating and describing risk, including the assumptions and level of uncertainty associated with the risk estimate. The measurement endpoints evaluated for each assessment endpoint constitute a line of evidence. A weight of evidence paradigm was then used to evaluate the multiple lines of evidence in the summary. This was accomplished by first characterizing risk for each individual line of evidence, and then characterizing risk based on all the available evidence.

The hazard quotient (HQ) method was used for all lines of evidence except toxicity and bioaccumulation testing. The HQ is expressed as measure of exposure divided by measure of effect. The measures of exposure in this ERA include measured COPEC concentrations in abiotic and biotic media, estimated COPEC concentrations in biotic media, and estimated COPEC intakes in wildlife. The measures of effect are media-specific benchmarks, critical body residues, and wildlife toxicity reference values. HQs for both low (NOAEL-based) and high (LOAEL-based) measures of effect (indicated as

HQnoaels and HQloaels, respectively) were calculated for the tissue residue evaluation and the food web modeling. HQs are generally interpreted as follows:

- An HQnoael less than 1 indicates that toxicological effects and potential risk are likely not occurring.
- An HQnoael greater than 1 and an HQloael less than 1 indicates that toxicological effects and potential risk may occur.
- An HQloael greater than 1 indicates that toxicological effects and potential risk are more likely to occur.

The most that can be concluded from a calculated HQ greater than 1 is that there is an increased potential that an adverse effect may occur in at least one individual. While this potential increases as the magnitude of the HQ increases, the level of concern does not increase linearly with increases in HQ. This lack of linearity is based on the fact that typical dose response curves for chemicals are not linear.

CERCLA, under which ERA guidance has been prepared, does not specify how the magnitude of HQs should be interpreted for risk characterization, and independent scientific literature also does not recommend thresholds for HQs for interpretation for risk characterization (USEPA, 1990; Suter, 2007). Scientists recognize that HQs are not a direct measure of ecological risk, but rather are a measure of the degree of potential concern (Tannenbaum et al., 2003). True measures of risk imply the probability that an adverse environmental effect will occur (*i.e.*, the fraction of a population that will potentially experience adverse effects). In practice, HQs are the only measure used in the ERA process to determine if adverse effects may be occurring in the environment. The unqualified and conservative interpretation of HQs in ERA for the purposes of remedial decision making has been criticized by the scientific community (*e.g.*, Tannenbaum et al., 2003), including the following specific criticisms:

- HQs cannot be interpreted based on assumptions of linearity
- HQs commonly exceed 1.0
- HQs are frequently unreasonably high

Despite these uncertainties in the utility of using HQ point estimates to infer risk to assessment endpoints, this metric has the advantage of being a standard practice. Uncertainty in ERA can be broken down into two general categories: those that can be quantified, such as variability (measurement error, systematic error, model uncertainty, and natural variation), and those that cannot be quantified because of imperfect knowledge (Regan et al., 2003, Kelly and Campbell, 2000). A discussion of sources of uncertainty in this ERA is provided in Section 6.

As discussed previously, the primary Site-related contaminants are PCBs and chlorinated VOCs. The potential for adverse health effects associated with exposure to all chemicals selected as refined COPEC was evaluated in this assessment, using the data sets described in Section 2 for biotic and abiotic media. However, the focus is on whether or not the potential for adverse health effects in ecological receptors may be associated with Site-related contaminants.

5.5.1 Protection of Benthic Invertebrates

Four lines of evidence were evaluated for the community-based assessment endpoint of long-term maintenance of survival, growth, and reproduction of the benthic invertebrate community. As summarized in Table 5-2, these include:

- Comparison of sediment/porewater data to screening concentrations protective of benthic invertebrates,
- Comparison of benthic invertebrate tissue data to invertebrate critical body residues,
- Evaluation of sediment toxicity tests, and
- Evaluation of bioaccumulation tests.

5.5.1.1 Comparison of Media Concentrations to Screening Benchmarks

Chemical concentrations in sediment were compared to ESVs protective of benthic invertebrates. The frequency of detection and range of detected concentrations for Surface Sediment in each exposure unit and reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit in Tables G-23 through G-30 in Appendix G; refined COPECs for sediment are summarized in Table 5-8. From the refined list of COPEC shown in Table 5-8, those chemicals with refined HQs greater than 1, by exposure unit, include:

- EU GB – 11 SVOCs (including 10 PAHs).
- EU BB1 – acetone, 18 SVOCs (including 15 PAHs), eight pesticides, total PCB Aroclors, six metals, and cyanide.
- EU BB2 – acetone, 17 SVOCs (including 14 PAHs), 5 pesticides, total PCB Aroclors, 5 metals, and cyanide.
- EU BB3 – acetone, 17 SVOCs (including 14 PAHs), 11 pesticides, total PCB Aroclors, 6 metals, and cyanide.
- EU BB4 – acetone, 18 SVOCs (including 14 PAHs), 10 pesticides, total PCB Aroclors, 6 metals, and cyanide.
- EU BB5 – 3 VOCs, 17 SVOCs (including 13 PAHs), 9 pesticides, total PCB Aroclors, 5 metals, and cyanide.
- EU BB6 – acetone, 10 SVOCs (including 9 PAHs), four pesticides, total PCB Aroclors, 6 metals, and cyanide.
- EU SL – acetone, 13 SVOCs (including 10 PAHs), two pesticides, three metals, and cyanide.

5.5.1.2 Tissue Residue Evaluation

Measured concentrations of bioaccumulative chemicals in invertebrate tissue were compared to derived CBRs shown in Table 5-24. As described previously, the crayfish data set and the Asiatic clam data set were each further separated into two data sets, based on the statistical evaluation in Appendix E: one applied to EUs GB, BB1, BB2, BB3, BB4, and BB5 and the other applied to EU BB6. Comparison of crayfish and clam tissue concentrations to invertebrate tissue CBRs is presented in Tables I-1 through I-4 in Appendix I. A summary of the resulting HQs is presented in Table 5-32.

As shown in Table 5-32 for clam tissue, HQnoael for total PCB Aroclors range from 2 at EU BB6 to 19 at the remaining EUs, while the HQloael range from less than 1 at EU

BB6 to 2 at the remaining EUs. The HQnoael and HQloael for TCDD TEQ (PCBs) were all less than 1. Although it has been shown that invertebrates are generally insensitive to PCB congeners that produce dioxin-like toxicity in other organisms (USEPA, 2008c) such that the toxicity equivalence methodology is not applicable to invertebrates, the fish TEFs (Van den Berg, 1998) were conservatively applied to calculate TCDD TEQ (PCBs) concentrations for comparison to CBRs. The low HQs for TCDD TEQ (PCBs) still reflect this lack of toxicity.

For crayfish tissue, HQnoael for total PCB Aroclors range from 13 at EUs GB, BB1, BB2, BB3, BB4, and BB5 to 20 at EU BB6, while the HQloael range from 1 at EUs GB, BB1, BB2, BB3, BB4, and BB5 to 2 at EU BB6.

The HQnoael for bioaccumulative metals detected in crayfish tissue range from less than 1 to 63 (silver) at EUs GB, BB1, BB2, BB3, BB4, BB5, and SL while the HQloael range from less than 1 to 6 (silver). At EU BB6, the HQnoael for these metals range from less than 1 to 29 (selenium), while the HQloael range from less than 1 to 3 (cadmium and selenium). The HQnoael and HQloael for copper were all 1 or less.

5.5.1.3 Sediment Toxicity and Bioaccumulation Testing

Whole sediment toxicity tests and sediment bioaccumulation tests were conducted during the OU4 RI in 2012 with samples collected within the Study Area and selected reference areas. The tests were conducted by Aqua Survey, Inc. (ASI), at their Flemington, New Jersey laboratory, from August to November 2012.

Test sediment samples were collected in EUs BB1, EU BB3, EU BB5 (all in Bound Brook) and EU BB2 (New Market Pond). Reference sediments for Bound Brook test sediments were collected in Ambrose Brook; reference sediments for New Market Pond test sediments were collected in Lake Nelson. ASI collected control sediments used in sediment tests from the pond on their property. Sample locations for both types of tests are shown on Figures 2-4 and 2-5.

Sediment toxicity test results were statistically compared to results for reference sediments. However, a statistically significant difference may not necessarily correspond to a toxic effect on test organisms. In an evaluation of sediment toxicity test methods conducted by the USEPA (1994b), sediment test results exhibiting a 20 percent or greater difference with control sediments were considered to be indicative of a toxic effect. Since ASI determined ‘significant difference’ by statistical comparison with reference sediments, the degree of toxic effect was evaluated by screening results in ‘significantly different’ test sediments for a ≥20 percent difference relative to results in corresponding reference sediments.

The USEPA (1994b) indicates that test sediment from different EUs that show toxic effects for the same endpoint can be compared by a “toxicity response” metric calculated from the following equation:

$$Toxicity\ Response = \frac{Endpoint\ Value, Test\ Sediment}{Endpoint\ Value, Reference\ Sediment}$$

The following sections briefly discuss the toxicity and bioaccumulation test results. Toxicity responses were calculated, where appropriate, and discussed below. ASI’s Technical Report, including their specific methodologies, analytical and statistical results, and supporting appendices, is provided in Appendix L.

Sediment Toxicity Tests with Hyalella azteca

Short-term and long term sediment toxicity tests were conducted with the amphipod *H. azteca*. The short-term test was 10 days in duration and measured both lethal (percent survival) and sublethal (organism weight) endpoints. The long-term test was 42 days in duration and included both a sediment exposure portion (days 0-28) that measured survival and weight, and a water-only exposure portion (days 28-42) that measured survival, weight and reproduction (as an additional sublethal endpoint).

Short-Term Test Results

Control survival met/exceeded the USEPA’s 80 percent performance criterion for a valid test. Survival in all tests sediments except BB-SD-02 were not statistically significantly different from that observed in the corresponding reference sediment. No effects on *H. azteca* growth were observed in test sediments.

Although survival in BB-SD-02 (EU BB3) was statistically significantly different, the observed survival (90 percent) was high, and not considered to be indicative of a toxic effect (USEPA 1994b).

Long-Term Test Results

Control survival in the 28 day sediment portion of the test met/exceeded the USEPA's 80 percent performance criterion for a valid test; there were no statistically significant differences in survival between test sediments and the corresponding reference sediment. At 28 days, the test methodology calls for specimens to be removed from the sediments; four replicates from each treatment were used to determine 28-day weight, while the remaining eight replicates per treatment continued the test in water-only test chambers.

Mean weights at 28 days in test sediments BB-SD-01 (0.41 mg) and BB-SD03 (0.39 mg) were statistically significantly different from the mean weight (0.60 mg) in the corresponding reference sediment. The 38 percent reduction in growth in BB-SD01 (EU BB5) and the 42 percent reduction in growth in BB-SD03 (EU BB1) compared to the corresponding reference sediment indicate a toxic effect. The following toxicity responses indicate that growth is reduced by the same degree at EU BB5 and EU BB1:

EU BB5: 0.41 mg/ 0.60 mg = 0.68

EU BB1: 0.39 mg/0.60 mg = 0.65

Mean weight at 28 days in test sediment NMP-SD01 (EU BB2) (0.30 mg) was statistically significantly different from mean weight (0.34 mg) in the corresponding reference sediment. However, the 12.5 percent reduction in growth between the two sediments is not large enough to indicate a toxic effect.

At test termination (42 days) there were no statistically significant differences in either survival or reproduction between test sediments and the corresponding reference sediments. There was a statistically significant difference in the mean weight in BB-SD03 (0.657 mg) and the mean weight (0.724 mg) in the corresponding reference sediment. However, the 9 percent reduction in growth between the two sediments in not large enough to indicate a toxic effect.

Sediment Toxicity Tests with Chironomus dilutus

Short-term and long term sediment toxicity tests were conducted with the chironomid *C. dilutus*. The short-term test was 10 days in duration, and measured both lethal (percent survival) and sublethal (organism weight) endpoints. The long-term test measured both lethal (survival) and sublethal (weight, emergence and reproduction) endpoints. Test duration depends upon reproduction, and is ended when there has been no larvae emergence from any treatment for seven consecutive days; typical test length is 50-65 days.

Short-Term Test Results

Control survivals met/exceeded the USEPA's 70 percent performance criterion and met the 0.48 mg control mean weight performance criterion for a valid test. There was no statistically significant difference in survival between test sediments and the corresponding reference sediment. There were statistically significant differences in mean weight between test sediments BB-SD01 (0.24 mg) and BB-SD03 (0.41 mg) compared to the mean weight (0.49 mg) in the corresponding reference sediment. The 68 percent reduction in growth in BB-SD01 (EU BB5) compared to the corresponding reference sediment indicates a toxic effect. However, the 18 percent reduction in growth in BB-SD03 (EU BB1) compared to the corresponding reference sediment is not large enough to indicate a toxic effect. Mean weight in test sediment NMP-SD01 (0.34 mg) was statistically significantly different than mean weight (0.42 mg) in the corresponding reference sediment. The 21 percent reduction in growth in NMP-SD01 (EU BB2) compared to the corresponding reference sediment indicates a toxic effect.

The following toxicity responses indicate that growth is reduced to a greater degree at EU BB5 than EU BB2:

EU BB5: 0.24 mg/0.49 mg = 0.49

EU BB2: 0.34 mg/0.42 mg = 0.81

Long-Term Test Results

Controls met/exceeded acceptable test criteria for 20 day survival, mean weight and percent emergence. The USEPA states that control sediments should average a mean number of 800 eggs per egg case for a valid test. The mean number of eggs per egg case in all test sediments was relatively high, exceeding this threshold, while the mean number of eggs per egg case were 655 and 834 for the reference sediments from Ambrose Brook and Lake Nelson, respectively.

Survival in test sediment BB-SD01 (14.6 percent) at 20 days was statistically significantly different from that observed in the corresponding reference sediment (81.3

percent); there was no statistically significant difference in survival between any other test sediment and the corresponding reference sediments. No significant differences in 20-day mean weight/surviving organism' were observed between test sediments and reference sediments. The 139 percent reduction in 20-day percent survival between BB-SD01 (EU BB5) and the corresponding reference sediment indicates a toxic effect.

Statistically significant differences in total percent emergence were observed in test sediments BB-SD01 (6.3 percent) and BB-SD03 (22.9 percent) compared to the corresponding reference sediment (47.9 percent), but no statistically significant differences were observed between test sediments and the corresponding reference sediments in other emergence parameters (rate of emergence per day and time to emergence in days). No statistically significant differences in the mean number of eggs/female were observed between test sediments and the corresponding reference sediments. The 153 percent reduction in total percent emergence in BB-SD01 (EU BB5) and the 70 percent reduction in total percent emergence in BB-SD03 (EU BB1) compared to the corresponding reference sediment indicates a toxic effect. The following toxicity responses indicate that emergence is reduced to a greater degree at EU BB5 than EU BB1.

EU BB5: 6.3 percent/47.9 percent = 0.13

EU BB1: 22.9 percent/47.9 percent = 0.48

Bioaccumulation Test with Lumbriculus variegates

A 28-day bioaccumulation test was conducted with the aquatic oligochaete *Lumbriculus variegates* using sediment samples collected in Bound Brook and New Market Pond. Tests with Bound Brook samples included three test sediments:(BB-SD01 (EU BB5), BB-SD02 (EU BB3) and BB-SD03 (EU BB1). Tests with New Market Pond samples included two test sediments: NMP-SD01 (EU BB2) and NMP-SD02(EU BB2). Reference sediments and test and reference sample locations were as described previously in the toxicity test discussion for *H. azteca*. The bioaccumulation test is designed to measure test organism survival, growth, and bioaccumulation.

Preliminary Screening Test

A preliminary 96- hour screening test was conducted to determine the feasibility of a long term bioaccumulation test. Significant mortality or unusual behavior (*e.g.*, lack of burrowing activity), if observed, would indicate that a bioaccumulation test might not produce usable results. Since, no significant mortality occurred in the test sediment, and test specimens were observed to burrow into the test sediments, the long term-test was subsequently conducted.

28 Day Bioaccumulation Test

There was no statistically significant difference in either survival or organism weight between test specimens in Bound Brook and New Market Pond sediments and the corresponding reference sediments.

Test specimen tissue samples were analyzed for PCB congeners by Axys Analytical Services, Ltd in British Columbia, Canada. Test specimens in Bound Brook and New Market Pond sediments had higher total PCB tissue residues than test specimens in the corresponding reference sediment. Sediment and tissue concentrations are summarized in Table 5-33. Tissue concentrations were corrected by subtracting the concentration of PCBs detected in untreated organisms in control sediment.

Biota-sediment accumulation factors (BSAFs) are a ratio of post-exposure organism total PCB concentration/sediment PCB concentration, corrected for organism lipid content and sediment total organic carbon. As shown in Table 5-33, test specimens in Bound Brook sediments had higher BSAFs than test specimens in reference sediment. Conversely, test specimens in New Market Pond sediments had lower BSAFs than test specimens in reference sediments. Observed BSAFs were generally similar to BSAFs listed in the U.S. Army Corps of Engineers BSAF database for this species (U.S. Army Corps of Engineers, 2009). Specimens exposed to EU BB1 sediments exhibited the greatest bioaccumulation.

5.5.1.4 Bioavailability of Metals in Sediment

The SEM-AVS data collected during the OU4 RI provide information on the site-specific bioavailability of the divalent metals: cadmium, copper, lead, nickel, and zinc. In aquatic environments, these metals may be present in a variety of forms that may be more or less available to aquatic organisms. AVS in sediment reacts with these metals, on a molar basis, to form insoluble sulfide complexes with minimal biological availability (USEPA, 2005f). If the AVS is present at concentrations in excess of the SEM concentrations, the metals will exist in the sediment as metal sulfides. If the SEM concentrations are greater than the AVS concentrations, the excess metals could potentially exist as more available free metals, if other constituents in the sediment porewater do not bind them. The metric used to evaluate these data is the ratio of the total SEM concentration in a sample to the corresponding AVS concentration. Ratios less than 1 indicate the metals are non-toxic (hence, not bioavailable) while ratios greater than 1 suggest the metals are potentially toxic (hence, bioavailable).

The SEM-AVS data for representative Site and reference area sediment samples are provided in Table 5-34. The total SEM/AVS ratios for Site sediment vary depending on the exposure unit. The ratios were less than or equal to 1 for all sediment samples from exposure units BB2 (0.2 and 0.2), BB3 (0.1 and 0.6), and BB4 (0.6, 1, and 1). Ratios were less than and/or greater than 1 for sediment samples from exposure units BB1 (0.4 and 2) and BB5 (3). The total SEM/AVS ratios for reference area sediment were comparable. With one exception, the ratios for the sediment samples were all less than or equal to 1 (0.1 to 1); one sediment sample from Ambrose Brook had a ratio (3) greater than 1. These results indicate that the divalent metals are generally non-toxic and, hence, not bioavailable to benthic organisms in these sediments.

Mercury is also a sulfide-forming metal, however as shown in Table 5-34, simultaneously extracted mercury was only detected in two of the Site sediment samples and three of the reference area sediment samples, at low concentrations (*i.e.*, at the reporting limit for the other samples).

The divalent metals also bind to other sediment phases, such as organic carbon, which can further reduce their bioavailability. The USEPA (2005f) suggests a modification of the SEM-AVS procedure in which the difference in the SEM and AVS concentrations is normalized to the corresponding fraction organic carbon (f_{oc}) in the sample, as follows, to account for the partitioning of these metals to sediment organic carbon as well as the effect of AVS: (total SEM – AVS)/f_{oc}. With two exceptions, all of the normalized concentrations in both Site sediment and reference area sediment indicate that the divalent metals should be non-toxic and, hence, not bioavailable, to benthic organisms in these sediments. The ratios for the sediment sample from exposure unit BB5 and one of the sediment samples from the reference area were in the range where the prediction of toxicity (hence, bioavailability) is uncertain.

5.5.2 Protection of Aquatic Life

Three lines of evidence were evaluated for the community-based assessment endpoint of long-term maintenance of survival, growth, and reproduction of the aquatic life community, and in particular the fish community. As summarized in Table 5-2, these include:

- Comparison of surface water/porewater data to screening concentrations protective of aquatic life,
- Comparison of fish tissue data to fish critical body residues, and
- Comparison of estimated concentrations in fish eggs to critical egg residues.

5.5.2.1 Comparison of Media Concentrations to Screening Benchmarks

Chemical concentrations in surface water and porewater were compared to ESVs protective of aquatic life in Tables 5-3 and 5-6, respectively. As shown in Table 5-3, The HQs for aluminum, manganese, and cyanide are each 2. As shown in Table 5-6, the HQ for vinyl chloride is 2, the HQ for total PCB Aroclors is 121, and the HQs for TCDD TEQ (PCBs) range from 65 (for fish) to 4,827 (for birds).

5.5.2.2 Tissue Residue Evaluation for Whole Body Fish

Measured concentrations of bioaccumulative chemicals in whole body fish tissue were compared to derived CBRs shown in Table 5-25. As described previously, the data set for predatory fish and the data set for bottom-feeding fish were each further separated into five data sets, based on the statistical evaluation in Appendix E: one applied to EUs GB, BB1, BB2, and BB3 and one each applied separately to EU BB4, EU BB5, EU BB6, and EU SL.

Comparison of predatory fish tissue concentrations to fish tissue CBRs is presented in Tables I-5 through I-9 in Appendix I. A summary of the resulting HQs is presented in Table 5-32. As shown in Table 5-32 for predatory fish tissue, HQnoael for total PCB Aroclors range from 40 at EU BB6 to 979 at EU BB5, while the HQloael range from 4 to 98. The HQnoael for TCDD TEQ (PCBs) range from less than 1 to 3 at EU BB5, while the HQloael are all less than 1. For total DDx HQnoael are all 1 or less. The HQnoael for the bioaccumulative metals detected in predatory fish range from less than 1 to 112 (cadmium at EUs GB, BB1, BB2, and BB3), while the HQloael range from less than 1 to 11.

Comparison of bottom-feeding fish tissue concentrations to fish tissue CBRs is presented in Tables I-10 through I-14 in Appendix I. A summary of the resulting HQs is presented in Table 5-32. As shown in Table 5-32 for bottom-feeding fish tissue, HQnoael for total PCB Aroclors range from 749 to 2,674 at EU BB5, while the HQloael range from 75 to 267. For TCDD TEQ (PCBs), HQnoael range from less than 1 to 9 at EU BB5, while HQloael are all 1 or less. Pesticides and metals were not analyzed in the whole body bottom-feeding fish tissue samples.

5.5.2.3 Tissue Residue Evaluation for Fish Eggs

Fish egg residues were estimated for the PCB congeners based on literature-based BMFs for the ratio of egg concentration to maternal whole body concentration (Cooke et al., 2003) adjusted for a site-specific average lipid content in whole body fish sample of 3.9 percent, as presented in Appendix I. Estimated fish egg concentrations were then compared to the fish egg CBRs shown in Table 5-26.

Comparison of estimated fish egg residue to fish egg CBRs is presented in Appendix I Tables I-15 through I-19 for predatory fish and in Tables I-20 through I-24 for bottom-feeding fish. A summary of the resulting HQs is presented in Table 5-32. As shown in Table 5-328 for TCDD TEQ (PCBs) in predatory fish eggs, the HQnoael for all EUs was 1 or less. For bottom-feeding fish eggs, the HQnoael for TCDD TEQ (PCBs) range from less than 1 to 2 at EU BB5, while the HQloael for all EUs are less than 1.

5.5.3 Protection of Semi-Aquatic Receptors

Two lines of evidence were evaluated for the population-based assessment endpoint of long-term maintenance of the survival, growth, and reproduction of semi-aquatic bird and mammal populations that inhabit/utilize the stream corridors within the Study Area. As summarized in Table 5-2, these include:

- Comparison of modeled intakes to toxicity reference values, and
- Comparison of estimated concentrations in bird eggs to critical egg residues.

5.5.3.1 Food Web Modeling

Intakes of bioaccumulative COPECs (in mg COPEC per kg body weight per day) based on total exposure from incidental ingestion of surface water for drinking, ingestion of dietary/prey items, and incidental ingestion of sediment, were divided by both NOAEL-based and LOAEL-based TRVs to calculate HQnoael and HQloael. The intake and HQ calculations for the representative semi-aquatic wildlife receptors (*i.e.*, mallard, red-winged blackbird, great blue heron, belted kingfisher, raccoon, little brown bat, and American mink) are presented by EU in Appendix K in the following tables:

- EU GB – Tables K-1 through K-9
- EU BB1 – Tables K-10 through K-18
- EU BB2 – Tables K-19 through K-27
- EU BB3 – Tables K-28 through K-36
- EU BB4 – Tables K-37 through K-45
- EU BB5 – Table K-46 through K-54
- EU BB6 – Tables K-55 through K-63
- EU SL – Tables K-64 through K-72

Intakes are shown for each exposure route (*i.e.*, water ingestion, dietary/prey ingestion, sediment ingestion). A summary of the resulting HQs for semi-aquatic birds is presented in Table 5-35 and for semi-aquatic mammals in Table 5-36.

As shown in Table 5-35, HQnoael for bird receptors are greater than 1 for total PCB Aroclors, TCDD TEQ (PCBs), copper, lead, and selenium for one or more receptor in one or more exposure units.

- HQnoael for total PCB Aroclors range from less than 1 to 84 and HQloael range from less than 1 to 8, with the highest HQs for belted kingfisher at EU BB5.
- HQnoael for TCDD TEQ (PCBs) range from less than 1 to 23 and HQloael range from less than 1 to 2, with the highest HQs for belted kingfisher at EU BB5.

- HQnoael for copper range from less than 1 to 9, with the highest HQs for red-winged blackbird at all EUs other than EU BB6; HQloael for copper are all 1 or less.

- HQnoael for selenium range from less than 1 to 3, with the highest HQs for red-winged blackbird at all EUs other than EU BB6; HQloael for selenium are all 1 or less.

- For lead, the only HQs greater than 1 were HQnoael for red-winged blackbird at EU BB6; all other HQs for lead were 1 or less.

As shown in Table 5-36, HQnoael for mammal receptors exceed 1 for total HMW PAHs, total PCB Aroclors, TCDD TEQ (PCBs), dieldrin, beta-endosulfan, endrin, cadmium, copper, selenium, and zinc for one or more receptor in one or more exposure units.

- HQnoael for total HMW PAHs, a COPEC for muskrat only, range from less than 1 to 5 (EU SL) and HQloael are all 1 or less.

- HQnoael for total PCB Aroclors range from less than 1 to 42 and HQloael range from less than 1 to 20, with the highest HQs for American mink at EU BB5.

- HQnoael for TCDD TEQ (PCBs) range from less than 1 to 71 and HQloael range from less than 1 to 7, with the highest HQs for American mink at EU BB5.

- HQnoael for dieldrin range from less than 1 to 28 (EU BB5) and HQloael are all less than 1.

- For beta-endosulfan, a COPEC for muskrat only, the HQnoael for EU BB5 is 5. All other HQs are less than 1.

- For endrin, a COPEC for muskrat only, the HQnoael for EU BB5 is 3. All other HQs are 1 or less.

- HQnoael for copper range from less than 1 to 7, with the highest for little brown bat at all EUs other than EU BB6; HQloael for copper are all 1 or less.

- HQnoael for selenium range from less than 1 to 5, with the highest HQs for little brown bat at all EUs other than EU BB6; HQloael for selenium are all 1 or less.

- HQnoael for zinc range from less than 1 to 3, with the highest HQs for little brown bat at all EUs other than EU BB6. HQloael for zinc are all less than 1.

- For cadmium the only HQs greater than 1 were HQnoael for little brown bat at EU BB6; all other HQs for cadmium were 1 or less.

5.5.3.2 Tissue Residue Evaluation for Bird Eggs

Bird egg residues were estimated for total DDx, total PCB Aroclors, and TCDD TEQ (PCBs) using literature-based BMFs (Braune and Norstrom, 1989) adjusted for a site-specific average lipid content in whole body fish samples of 3.9 percent, as presented in Appendix I. Estimated bird egg concentrations were then compared to the bird egg CBRs shown in Table 5-27.

Comparison of estimated bird egg residue to bird egg CBRs is presented in Appendix I Tables I-25 through I-29 based on predatory fish whole body concentrations and in Tables I-30 through I-34 based on bottom-feeding fish whole body concentrations. A summary of the resulting HQs is presented in Table 5-32.

For bird egg residues based on predatory fish tissue concentrations, the total DDx HQnoael and HQloael are all less than 1. The total PCB Aroclors HQnoael range from 16 at EU BB6 to 395 at EU BB5, while the HQloael range from 2 at EU BB6 to 40 at EU BB5. The TCDD TEQ (PCBs) HQnoael range from 247 at EU BB6 to 4,672 at EU BB5, while the HQloael range from 25 at EU BB6 to 467 at EU BB5.

For bird egg residues based on bottom-feeding fish tissue concentrations, total PCB Aroclors HQnoael range from 359 at EU BB6 to 1,078 at EU BB5, while the HQloael range from 36 at EU BB6 to 109 at EU BB5. The TCDD TEQ (PCBs) HQnoael range from 190 at EU BB6 to 11,925 at EU BB5, while the HQloael range from 19 at EU BB6 to 1,193 at EU BB5.

5.5.4 Protection of Terrestrial Plants and Soil Invertebrates

One line of evidence was evaluated for the community-based assessment endpoint for the long-term maintenance of a healthy and diverse plant community. As summarized in Table 5-2, this line of evidence is the comparison of floodplain soil data to screening concentrations protective of plants.

Two lines of evidence were evaluated for the community-based assessment endpoint for long-term maintenance of survival, growth, and reproduction of the soil invertebrate community. As summarized in Table 5-2, these lines of evidence are the comparison of floodplain soil data to screening concentrations protective of soil invertebrates and evaluation of soil bioaccumulation tests.

5.5.4.1 Comparison of Media Concentrations to Screening Benchmarks

Chemical concentrations in Surface Soil were compared to ESVs protective of terrestrial plants and soil invertebrates. The frequency of detection and range of detected concentrations for Surface Soil in each exposure unit and the reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit are presented in Tables G-39 through G-45 in Appendix G; refined COPECs are summarized in Table 5-8. From the refined list of COPEC shown in Table 5-8, those chemicals with either refined HQs greater than 1 include:

- EU GB – 4 metals.
- EU BB1 – 6 metals.
- EU BB2 – 2 metals.
- EU BB3 – 10 metals.
- EU BB4 – aldrin and 9 metals.
- EU BB5 – HMW PAHs and 9 metals.
- EU BB6 – total PCB Aroclors and aluminum.

5.5.4.2 Soil Bioaccumulation Testing

Soil bioaccumulation tests were conducted with floodplain surface soil samples collected within the Study Area and the corresponding reference area in August 2012. The tests were conducted with the Lumbricid earthworm *E. fetida* by ASI, at their Flemington, New Jersey laboratory, from September to October 2012. ASI's Technical Report, including their specific methodologies, analytical and statistical results, and supporting appendices, is provided in Appendix L.

Test soil samples for the soil bioaccumulation test were collected in exposure units BB1 (one sample) and BB4 (two samples); reference soils were collected in the Ambrose Brook floodplain; control soil for the earthworm bioaccumulation test was formulated according to the ASTM method (2004). Sample locations for both types of tests are shown on Figures 2-4 and 2-5. Control soil was artificial soil prepared in accordance with the ASTM Method (2004).

Preliminary Screening Test

A preliminary 96- hour screening test was conducted to determine the feasibility of a long-term bioaccumulation test. Significant mortality or unusual behavior (*e.g.*, lack of burrowing activity), if observed, would indicate that a bioaccumulation test might not produce usable results. Since no significant mortality occurred in the test soil, and test specimens were observed to burrow into the test soil, the long-term test was subsequently conducted.

28-Day Bioaccumulation Test

A 28-day bioaccumulation test was conducted with *E. fetida* using soil samples collected in the Bound Brook floodplain and reference soil collected in the Ambrose Brook floodplain; the locations are shown on Figure 2-5 and Figure 2-4, respectively. Tests with Bound Brook samples included three test soils (BB-SL01 and BB-SL02 in EU BB4 and BB-SL03 in EU BB1). In addition to the reference soil, the test included a field duplicate.

Survival in the reference soil (98 percent) met/exceeded the ASTM International's 90 percent performance criterion for a valid test (ASTM, 2000c). The tests are designed to measure test organism survival, growth, and bioaccumulation. There were no statistically significant differences in either survival or organism weight between the test soils and the corresponding reference soil.

Earthworm tissue samples were analyzed for PCB congeners by Axys Analytical Services, Ltd in British Columbia, Canada. Test specimens in Bound Brook soils had higher total PCB tissue residues than test specimens in the corresponding reference soil.

Soil and earthworm tissue concentrations were presented previously in Table 5-22. These concentrations were corrected for PCBs detected in untreated test organisms in control soil. Soil-to-earthworm BAFs, the ratio of post-exposure organism total PCB concentration to total PCB concentration in soil, are also presented. As shown in Table 5-22, test specimens in Bound Brook soils had higher BAFs than test specimens in reference soil. As previously discussed, a site-specific soil-to-earthworm BAF was calculated as the average BAF of the three Bound Brook samples and was used to estimate PCB concentrations in earthworms to model dietary intakes of invertebrates for three terrestrial receptors (*i.e.*, American Robin, short-tailed shrew, and red fox).

5.5.5 Protection of Terrestrial Wildlife

Two lines of evidence were evaluated for the population-based assessment endpoint of long-term maintenance of the survival, growth, and reproduction of terrestrial bird and mammal populations that inhabit/utilize the floodplains of the stream corridors within the Study Area. As summarized in Table 5-2, these include:

- Comparison of floodplain soil data to screening concentrations protective of wildlife, and

- Comparison of modeled intakes to toxicity reference values.

5.5.5.1 Comparison of Media Concentrations to Screening Benchmarks

Chemical concentrations in Surface Soil were compared to ESVs protective of terrestrial wildlife. The frequency of detection and range of detected concentrations for Surface Soil in each exposure unit and the reference area, the 95% UCLs, ESVs, and refined HQs are presented for each exposure unit are presented in Tables G-46 through G-52 in Appendix G; refined COPECs are summarized in Table 5-8 . From the refined list of COPEC shown in Table 5-8, those chemicals with refined HQs greater than 1 include:

- EU GB – HMW PAHs, total PCB Aroclors, 5 metals.

- EU BB1 – HMW PAHs, 2 pesticides, total PCB Aroclors, 5 metals, and cyanide.

- EU BB2 – HMW PAHs, total PCB Aroclors, and selenium.

- EU BB3 – 3 SVOCs, HMW PAHs, 3 pesticides, total PCB Aroclors, and 11 metals.
- EU BB4 –3 SVOCs, HMW PAHs, 4 pesticides, total PCB Aroclors, and 10 metals.
- EU BB5 – 4 SVOCs, HMW PAHs, 4 pesticides, total PCB Aroclors, and 10 metals.
- EU BB6 – bis(2-ethylhexyl) phthalate, HMW PAHs, 2 pesticides, total PCB Aroclors, cadmium, and cyanide.

5.5.5.2 Food Web Modeling

Intakes of bioaccumulative COPECs (in mg COPEC per kg body weight per day) based on total exposure from ingestion of surface water for drinking, ingestion of dietary/prey items, and incidental ingestion of soil, were divided by both NOAEL-based and LOAEL-based TRVs to calculate HQnoael and HQloael. The intake and HQ calculations for the representative terrestrial wildlife receptors (*i.e.*, mourning dove, American robin, red-tailed hawk, eastern gray squirrel, short-tailed shrew, and red fox) are presented by exposure unit in Appendix K in the following tables:

- EU GB – Tables K-73 and K-78
- EU BB1 – Tables K-79 and K-84
- EU BB2 – Tables K-85 and K-90
- EU BB3 – Tables K-91 and K-96
- EU BB4 – Tables K-97 and K-102
- EU BB5 – Tables K-103 and K-108
- EU BB6 – Tables K-109 and K-114

Intakes are shown for each exposure route (*i.e.*, water ingestion, dietary/prey ingestion, soil ingestion). A summary of the resulting HQs for terrestrial birds is presented in Table 5-37 and for terrestrial mammals in Table 5-38.

As shown in Table 5-37, HQnoael for bird receptors are greater than 1 for total PCB Aroclors for the American robin at all EUs except EU GB. HQnoael for total PCB Aroclors range from 1 to 732 and HQloael range from less than 1 to 73, with the highest HQs for American robin at EU BB6. HQs for the remaining COPECs and receptors are all 1 or less.

As shown in Table 5-38, HQnoael for mammal receptors are greater than 1 for total PCB Aroclors, dieldrin, and zinc for one or more receptor in one or more EUs.

- HQnoael for total PCB Aroclors range from less than 1 to 152 and HQloael range from less than 1 to 15, with the highest HQs for short-tailed shrew at EU BB6.
- For dieldrin, the HQnoael is 19 and HQloael is less than 1 for eastern gray squirrel at EU BB5; all other HQs for dieldrin are 1 or less.
- For zinc, the HQnoael is 2 and HQloael is less than 1 for eastern gray squirrel at EU BB3; all other HQs for zinc are 1 or less.

5.5.6 Discussion of Ecological Risks for Non-Site-Related COPECs

Since the focus of the risk assessment is on the primary Site-related contaminants (*i.e.*, PCBs and chlorinated VOCs), the potential for adverse health effects in ecological receptors associated with exposure to COPECs that are not Site-related is discussed below by chemical class.

5.5.6.1 Volatile Organic Compounds

Of the refined volatile COPECs that are not Site-related (Table 5-8), acetone (EUs BB1, BB2, BB3, BB4, BB5, BB6, and SL) and toluene (EU BB5) were detected in Surface Sediment at concentrations greater than the ESVs resulting in HQs greater than 1 and indicating a potential for adverse health effects in benthic invertebrates. Acetone and toluene, however, are common laboratory contaminants. Several other non-Site-related VOCs were detected in Surface Sediment or Surface Soil but were not retained as refined COPECs due to their infrequent detection. Non-Site-related VOCs detected in surface water included 2-butanone and chlorobenzene, at concentrations below ESVs (Table 5-3). Several VOCs were retained as refined COPECs due to the lack of ESVs (Table 5-8).

5.5.6.2 Semi-Volatile Organic Compounds

Seven SVOCs retained as refined COPECs [*i.e.*, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, diethylphthalate, 2-methylnaphthalene, 3-/4-methylphenol, and phenol] were detected in Surface Sediment and Surface Soil in one or more EUs at concentrations greater than the ESVs (HQs greater than 1) (Table 5-8); indicating the potential for adverse health effects in benthic invertebrates (Surface Sediment) or birds and mammals (Surface Soil). Although accumulation in tissue does not necessarily indicate toxicity, both bis(2-ethylhexyl) phthalate and di-n-butyl phthalate were detected in crayfish tissue collected during the USEPA's 1997 Ecological Evaluation (USEPA, 1999a). bis(2-Ethylhexyl) phthalate was detected in 1 of 16 surface water samples collected in Bound Brook during the RI of the Woodbrook Site (TRC Environmental Corporation, 2007) at a concentration exceeding the ESV (Table 5-6). Phthalates are also common laboratory contaminants.

Because these SVOCs are not bioaccumulative they were not evaluated further in the tissue residue evaluation or food web modeling in this assessment. However, two other SVOCs (*i.e.*, 1,2- dichlorobenzene and 1,3-dichlorobenzene) selected as refined COPECs in Surface Sediment for evaluation of semi-aquatic herbivorous receptors (*i.e.*, wood duck and muskrat) are bioaccumulative and were included in food web modeling for these receptors, but HQs were not calculated due to the lack of TRVs. Two additional SVOCs (*i.e.*, bis(2-chloroethyl) ether and bis(2-chloroisopropyl)ether) detected in Surface Soil at EU BB3 were not retained as refined COPEC due to their infrequent detection. Several SVOCs were retained as refined COPECs due to the lack of ESVs (Table 5-8).

5.5.6.3 Polycyclic Aromatic Hydrocarbons

Fifteen individual PAHs were retained as refined COPECs in Surface Sediment at multiple EUs throughout the OU4 Study Area (including EUs GB, BB1 through BB6, and SL) (Table 5-8). Based on comparison of detected concentrations Surface Sediment to ESVs resulting in HQs greater than 1, there is a potential for adverse health effects in benthic invertebrates. Sixteen individual PAHs were detected in one or more surface water samples collected in Bound Brook during the RI of the Woodbrook Site (TRC Environmental Corporation, 2007) (Table 5-6). Of these benzo(a,h)anthracene and benzo(a)pyrene were detected at concentrations exceeding ESV (Table 5-6).

The nature and extent of PAH contamination in sediment within the OU4 Study Area is described further in the RI report. As described in the OU4 RI Report (see Section 5.3), using benzo(a)pyrene as representative of HMW PAHs and fluorene as representative of LMW PAHs, a contamination pattern emerged showing widespread surface sediment contamination along Bound Brook from RM0 to RM7 where bridges, roads, and stormwater outfalls are located, and lower contamination levels observed upstream of RM7 and in Green Brook, where water ways are bordered by wetlands and undeveloped floodplain. Based on the evaluation presented in the RI report, the largest PAH inventory in sediments appear to be located from approximately RM2 to RM5.

Total HMW PAHs were retained as refined COPECs based on comparison of detected concentrations in Surface Soil to ESVs protective of plants and terrestrial invertebrates in EU BB5 (Table 5-8); indicating a potential for adverse health effects. Total HMW PAHs were also retained as refined COPECs based on comparison of detected concentrations in Surface Soil to ESVs protective of birds and mammals in all EUs (except EU SL where no floodplain surface soil was sampled) (Table 5-8); indicating a potential for adverse health effects. While PAHs are bioaccumulative, they were not detected in biota tissue samples, where analyzed. Therefore, PAHs were not evaluated in the tissue residue evaluation or food web modeling for insectivorous, piscivorous, or carnivorous birds and mammals in this assessment. However, based on estimated PAH concentrations in plants growing in Surface Sediment or Surface Soil and subsequent dietary exposure to higher trophic level organisms (*i.e.*, wood duck, muskrat, mourning dove and eastern gray squirrel) (Tables 5-35 through 5-38), semi-aquatic mammals may be at increased risk from exposure to HMW PAHs (HQnoaels greater than 1) and terrestrial herbivorous receptors are not likely at risk for adverse health effects associated with exposure to PAHs in Surface Soil (HQnoaels and HQloaels less than 1) within the OU4 Study Area.

5.5.6.4 Pesticides

Twelve pesticides (*i.e.*, aldrin, beta-BHC, gamma-BHC, total chlordane, dieldrin, total DDx, alpha- and beta-endosulfan, endrin, heptachlor, heptachlor epoxide, and methocxychlor) were retained as refined COPECs in Surface Sediment in one or more EUs (including EUs BB1 through BB6 and SL) based on comparison of detected concentrations to ESVs (Table 5-8) indicating the potential for adverse health effects in benthic invertebrates. Of these only total DDx and heptachlor epoxide were detected in biota tissue samples (whole body predatory fish only). Based on tissue residue evaluation for whole body predatory fish (Table 5-32), the bird egg residue evaluation (Table 5-32), and food web modeling for semi-aquatic piscivorous birds (*i.e.*, great blue heron and belted kingfisher) (Table 5-35) and mammals (*i.e.*, American mink) (Table 5-36), and omnivorous mammals (*i.e.*, raccoon) (Table 5-36), it is unlikely that exposure to total DDx or heptachlor epoxide is associated with adverse health effects in aquatic life (fish) or semi-aquatic birds or mammals within the OU4 Study Area (all HQs less than 1). Only endrin ketone was retained as a refined COPEC in Surface Sediment due to the lack of an ESV.

Seventeen pesticides were included as refined COPECs for evaluation of herbivorous semi-aquatic wildlife. Based on estimated pesticide concentrations in aquatic plants, for these 17 pesticides, and subsequent dietary exposure to higher trophic level organisms (*i.e.*, wood duck and muskrat) (Tables 5-37 and 5-38), terrestrial herbivorous mammals may be at increased risk for adverse health effects from exposure to dieldrin at EUs BB5 and BB6 (HQnoael greater than 1), beta-endosulfan at EU BB5 (HQnoael greater than 1), and endrin at EUs BB4 and BB5 (HQnoael greater than 1) within the OU4 Study Area.

Of the pesticides detected in Surface Soil, only aldrin was detected at a concentrations greater than the ESVs protective of plants and invertebrates (Table 5-8) indicating a potential for adverse health effects. Thirteen pesticides (*i.e.*, alpha-BHC, delta-BHC, gamma-BHC, total chlordane, dieldrin, total DDx, alpha-endosulfan, beta-endosulfan, endrin, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, and methoxychlor) were retained as COPECs in Surface Soil due to the lack of ESVs protective of plants and invertebrates.

Seven pesticides (*i.e.*, dieldrin, total DDx, beta-endosulfan, endrin aldehyde, heptachlor, heptachlor epoxide, and methoxychlor) were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals (Table 5-8). Of these, only dieldrin and heptachlor epoxide were detected in mouse tissue samples. CBRs were not available to evaluate toxicity of these two pesticides in mouse tissue. However, based on food web modeling for terrestrial carnivorous (*i.e.*, red-tailed hawk) (Table 5-37) and mammals (*i.e.*, red fox) (Table 5-38), it is unlikely that exposure to dieldrin or heptachlor epoxide is associated with adverse health effects in terrestrial birds or mammals within the OU4 Study Area (all HQs less than 1). In addition, based on estimated pesticide concentrations in plants, for the twelve pesticides retained as refined COPECs, and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel) (Tables 5-37 and 5-38), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to pesticides in soil (HQs less than 1 except for dieldrin in EU BB5 where the HQnoael was 19) within the OU4 Study Area. Five pesticides (*i.e.*, aldrin, beta-BHC, gamma-BHC, total chlordane, and endrin ketone) were retained a refined COPECs due to the lack of ESVs protective of birds and mammals.

5.5.6.5 Metals and Cyanide

Eight metals, excluding the essential nutrients, and cyanide were detected in surface water samples. Of these aluminum, manganese, and cyanide were retained as refined COPECs based on comparison of detected concentrations to ESVs protective of aquatic life (Table 5-3) indicating a potential for adverse health effects in aquatic life (HQs greater than 1).

Eight metals (*i.e.*, cadmium, copper, lead, manganese, mercury, nickel silver, and zinc) and cyanide were retained as refined COPECs in Surface Sediment in one or more EUs based on comparison of detected concentrations to ESVs protective of benthic invertebrates; indicating a potential for adverse health effects. The bioaccumulative metals arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were detected in aquatic biota tissue samples (predatory fish and/or crayfish). Based on tissue residue evaluation for crayfish (Table 5-32), HQnoael and HQloael for arsenic, selenium, silver, and zinc were greater than 1 at all EUs, including EU SL (except arsenic at EU BB6). For chromium, lead, mercury, and nickel detected in crayfish, HQnoael range from 1 to 11, but the HQloael are all 1 or less. HQnoael and HQloael for cadmium in EU BB6 were greater than 1 while cadmium HQnoaels are greater than 1 and HQloaels are 1 for all other EUs. Arsenic, chromium, and nickel were not detected in crayfish tissue in EU BB6. The tissue residue evaluation indicates that metals concentrations may be capable of causing adverse health effects in benthic invertebrates within the OU4 Study Area.

However, evaluation of the bioavailability of the divalent metals (*i.e.*, cadmium, copper, lead, nickel, and zinc) based on total SEM/AVS ratios in all samples and organic carbon normalized AVS and SEM concentrations [(total SEM – AVS)/f_{oc}] in all samples but from EU BB5 and the reference area indicate that metals are generally not bioavailable to benthic organisms in these sediments (Table 5-34). However, this is contradictory to the accumulation seen in crayfish tissue samples from Bound Brook. The organic carbon normalized AVS and SEM concentrations indicates that sediment from EU BB5 and the reference area are within the range of prediction, where bioavailability is uncertain.

Based on tissue residue evaluation for whole body predatory fish (Table 5-32), HQnoael and HQloael for cadmium (EUs GB, BB1, BB2, BB3, BB4, BB5), lead (EUs GB and BB1 to BB6), mercury (EU BB5), selenium (EUs GB and BB1 to BB6), silver (EUs BB4, BB5, BB6), and zinc (EUs GB and BB1 to BB6) are greater than 1. HQnoael for arsenic (EUs GB, BB1, BB2, BB3), mercury (EUs GB, BB1 to BB4, and BB6), and silver (EUs GB, BB1, BB2, BB3) were greater than 1. The tissue residue evaluation indicates that metals concentrations may be capable of causing adverse health effects in fish within the OU4 Study Area.

Twelve metals (*i.e.*, aluminum, barium, chromium, copper, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of terrestrial plants and invertebrates (Table 5-8). Iron and cyanide were retained as refined COPECs in Surface Soil due to the lack of ESVs.

Eleven metals (*i.e.*, antimony, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium, vanadium, and zinc) and cyanide were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals.

The bioaccumulative metals arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were not analyzed in mouse tissue samples. However, based on estimated bioaccumulative metals concentrations in plants and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel) (Tables 5-37 and 5-38), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to metals in soil (HQs less than 1 with the exception of zinc at EU BB3 where the HQnoael was 2) within the OU4 Study Area.

The nature and extent of metals contamination within the OU4 Study Area are described further in the RI report. As discussed in the OU4 RI Report (see Section 6.2.2), metals concentration gradients observed in recently-deposited sediments have the same trend as concentration gradients observed in the low resolution core surface sediment samples used in this risk assessment. Scatter plots of absolute and iron-normalized metals concentrations in recently-deposited sediments for select metals are presented in Figures 5-1a to 5-1l. The scatter observed in the low resolution core datasets is reduced in the recently-deposited sediments because the recently-deposited sediment samples represent a single fine-grained sediment texture (top panel). The scatter is further minimized with iron-normalization. Based on these plots, three types of metals concentration gradients are observed in the dataset:

1. Arsenic, manganese, and nickel have relatively uniform normalized concentration gradients across the OU4 Study Area, suggesting no significant source of these metals exists within the OU4 Study Area.

2. Cadmium has a pronounced decreasing normalized concentration gradient downstream from the Talmadge Road Bridge on Bound Brook (RM8.3) to the Shepherd Avenue Bridge on Green Brook (RM-1.6). The upstream cadmium source is currently unknown; however, NJDEP has documented Hybrid Printhead as a cadmium contaminated site (refer to RI Section 2.5.3).

3. Antimony, chromium, copper, lead, mercury, silver, thallium, and zinc appear to be impacted by a metals source near the New Brunswick Avenue Bridge. [The MRP Steel Fabrication & Engineering, a steel fabrication facility, is located adjacent to Bound Brook from RM4.7 to RM5.0.]

Overall, the former CDE facility is not contributing a significant metals contaminant load to Bound Brook relative to the upstream metals concentrations.

Scatter plots of absolute and iron-normalized metals concentrations for select metals in floodplain surface soil samples collected during the OU4 RI are presented in Figures 5-2a to 5-2f. With the exception of zinc, the scatter observed in the OU4 RI floodplain surface soil samples datasets is reduced with iron-normalization. Based on these plots, these metals are have relatively uniform normalized concentration gradients across the OU4 Study Area, with the exception of detections just downstream of the twin culverts (EU BB4) and upstream of the New Brunswick Avenue Bridge (EU BB3). However, these metals in floodplain surface soil are not attributable to the former CDE facility.

6 Uncertainty Evaluation

Risk assessment involves the integration of complex analyses of chemical concentrations in the environment, the fate and transport of chemicals in the environment, the potential for exposure of human and ecological receptors, and the chemical potency and/or toxicity. Some uncertainties are associated with each component in this process.

Uncertainty in a risk assessment is typically accounted for by identifying the sources of uncertainty and characterizing whether the risks may be over-estimated or under-estimated. Within this section, sources of uncertainty in this BHHRA and ERA are briefly discussed. Joint discussion of the uncertainty associated with the data evaluation is made, followed by separate discussions of the uncertainty associated with the fate and transport modeling, exposure assessment/exposure and effects analysis, and toxicity assessment components of the BHHRA and ERA.

6.1 Data Evaluation

The potential for exposure and adverse health effects may be over- or under-estimated depending on how well the various environmental media were characterized. Sampling and analysis, data selection, and the approach of grouping data into separate EUs contribute to uncertainty in the risks and hazards estimated in the BHHRA and ERA. Uncertainty associated with environmental sampling is generally related to limitations in terms of the number and distribution of samples, while uncertainty associated with the analysis of samples is generally related to systematic or random errors (*i.e.,* false positive or negative results).

The risk assessment is based on an extensive set of environmental data, representing a variety of potential exposure media (*i.e.,* surface water, porewater, sediment, floodplain soil, fish, and shellfish) and characterizing spatial and temporal variability. Procedures detailed in the USEPA-approved OU4 RI/FS Work Plan (LBG/MP, 2010a), FSP (LBG/MP, 2010b), QAPP (LBG/MP, 2010c), and associated field modifications (described in Section 1.0) were followed to reduce the uncertainty associated with sampling performed during the OU4 RI. Independent validation of the laboratory data was performed, much of it by USEPA Region 2, to reduce uncertainty associated with the sample analyses. As stated in Section 2.3, the majority of the environmental data is of acceptable quality overall but subject to the data validator's qualifying remarks.

As shown in various data summary tables, sample reporting limits for some non-detect chemicals were greater than risk-based screening levels. Therefore, some non-detect chemicals may actually be present at concentrations that pose a human or ecological health risk. For example, evaluation of the surface water data collected for the Woodbrook Site RI (presented in Section 4.1.1.2) indicated PAHs may be present in Bound Brook, even though these chemicals were not detected in the whole water grab samples collected for the OU4 RI. Reporting limits for PAHs in the OU4 RI grab samples were much greater than in the Woodbrook Site RI samples, and in some cases were greater than the RSLs for tapwater. In addition, PCBs were detected in the OU4 RI surface water samples collected during the porewater sampling program, at concentrations ranging between 0.0048 and 0.26 µg/L, which are less than the reporting limit of 1 µg/L for the whole water grab samples, in which PCBs were not detected.

Some of the environmental data were collected as long ago as 1997 and, therefore, it is possible that these data may not accurately reflect current conditions. However, as indicated in the RI Report, there was reasonably good agreement between the earliest historic data, later confirmatory data, and data collected during the OU4 RI. Combining these data served to better represent long-term average chemical concentrations in the various environmental media such that the risks and hazards may be over-estimated rather than under-estimated.

The environmental data were grouped into EUs to facilitate RI/FS decision making. EU boundaries were based on historic PCB concentrations and physical features of the Site and Bound Brook system, with boundaries adjusted to key landmarks (*e.g.,* major cross streets/bridges). There was, nevertheless, a small arbitrary component to establishing the boundaries such that risks and hazards may be slightly over- or under-estimated for some EUs, depending on the inclusion or exclusion of some data. In addition, separation of the comprehensive database into smaller data sets, specifically for sediment and floodplain soil samples, reduced the likelihood that relatively elevated concentrations representative of localized hotspots were effectively “diluted” in the calculation of EPCs. However, it is still possible that localized hotspots were overlooked within a given EU and risks were consequently under-estimated.

The 2011 low resolution sediment core samples were analyzed through CLP, and Aroclor 1254 was the predominant PCB Aroclor mixture identified, quantified, presented, and discussed in the RI Report (LBG, 2012). For this analytical method, identification of an Aroclor is based on pattern recognition in conjunction with the elution of a minimum of three chromatographic peaks. If the Aroclor-pattern is not recognized or if less than three Aroclor-specific peaks are quantifiable, the laboratory will not report the PCB Aroclor. Consequently, a non-detected Aroclor value as reported by this analytical method does not imply that the Aroclor is not present; it may reflect the inability of the laboratory to identify and quantify it.

As discussed in the RI Report, the Ekman dredge surface sediment samples and sediment trap samples (not used in this risk assessment) were analyzed for PCB congeners and homologues by LBG's subcontracted laboratory (Axys Analytical Services, Ltd)[26]. For these samples, the analytical method detects and quantifies individual and co-eluting PCB congeners, and therefore, more accurately represents the total PCB contamination in the OU4 Study Area. Moreover, a review of the PCB congener data revealed that lighter PCB congeners (such as dichlorobiphenyl and trichlorobiphenyl) as well as heavier PCB congeners (such as octachlorobipheyl and nonachlorobiphenyl) are present in the Bound Brook samples. Consequently, total PCB reported as a sum of congeners is expected to have a higher concentration than the CLP Aroclor 1254 data because Aroclor 1254 (which represents mainly tetrachlorobiphenyl and pentachlorobiphenyl) by itself does not account for all the PCB congeners in a sample. For example, at RM6, the total PCB (sum of congeners) concentrations in the surface sediment/sediment trap samples range from 21-30 mg/kg (three samples between RM6.02 and RM6.06) while the CLP Aroclor 1254 concentrations range from 1.0 to 2.3 mg/kg (six samples between RM5.99 and RM6.16). Moreover, based on the PCB congener data, Aroclor 1254 (as estimated based on an empirical formula of summed PCB congeners) accounts for approximately 75 percent of the total PCB concentrations (refer to Section 6.4.3). Using this estimated percentage of Aroclor 1254 approach, in the example above, Aroclor 1254 concentrations at RM6 would be anticipated to be approximately 15-23 mg/kg (opposed to the 1-2 mg/kg reported through the CLP program). Additional discussion is provided in the RI Report. While co-located sediment samples were not simultaneously analyzed by CLP and a

[26] The April 2011 sediment samples were analyzed following Axys Analytical Services SOP MLA 010, which is based on USEPA Method 1668A. The November 2011 sediment samples were analyzed following Axys Analytical Services SOP MLA 007, which is based on a modified version of USEPA Method 608. For both methods, the laboratory quantified PCB congeners and PCB homologues. Sediment samples were spiked with a suite of ^{13}C labeled PCB surrogate standards, mixed with anhydrous sodium sulfate, and soxhlet extracted in dichloromethane. The extracts were cleaned up by adsorption chromatography on layered acidic, neutral, and basic silica gel, then on alumina (for high resolution mass spectrometry analysis only) followed by fractionation on Florisil. Extracts were analyzed by either gas chromatography with a mass spectral detector (SOP MLA-007) or by gas chromatography with high resolution mass spectrometric detection (SOP MLA-010). Individual PCB congeners were quantified by a combination of isotope dilution and internal standard methods.

subcontractor laboratory, these data indicate that the PCB Aroclor data as reported by CLP are biased low and do not accurately represent total PCB concentrations in the OU4 Study Area. Therefore, as a result, the estimated risks and hazards are also biased low and may be higher than estimated in this risk assessment.

Finally, risk-based screening levels were not available for all detected chemicals. Although these chemicals were selected as COPCs/COPECs, they were not evaluated quantitatively. Therefore, the potential for adverse health effects may be under-estimated. Summaries of adverse health effects associated with exposure to COPCs/COPECs that lack risk-based screening levels (and therefore toxicity values as well) are presented in Sections 6.2 and 6.3.

6.2 BHHRA Uncertainty

6.2.1 Fate and Transport Modeling

EPCs for non-volatile COPCs released from floodplain soil into outdoor air were estimated from screening-level emission/release calculations and atmospheric dispersion modeling. Due to their relative simplicity, these calculations and models tend to over-estimate these processes. For example, source depletion over time (*e.g.,* through COPC release or environmental degradation) was not accounted for, vegetated cover was assumed to be only 50 percent, and releases from 0.5-acre parcels were modeled as area sources whereas COPC emission/release, if it even occurs, could be from much smaller areas. Uncertainty associated with such modeling is related to the accuracy with which environmental conditions and processes are simulated. Overall, the potential inhalation exposure scenarios were modeled in ways that likely over-estimate the potential for exposure and adverse health effects.

6.2.2 Human Exposure Modeling

The exposure assessment relies on a series of assumptions regarding the potential for human exposure, outlined in the human health CSEM and approximated in the daily intake calculation by parameters such as the EPC and receptor-specific exposure duration, frequency, and time. This BHHRA attempted to address some of the uncertainty in these assumptions by conservatively evaluating the potential for cancer risk and non-cancer hazard to individuals under RME conditions in the various current/future exposure scenarios. The assessment primarily relied on the USEPA’s standard default exposure assumptions which are used at Superfund sites across the country with appropriate modifications to reflect site-specific conditions. The intention is to over-estimate the potential for risk and hazards, so that actual risks are less than those predicted in this BHHRA.

While specific aspects of the exposure assessment methodology, discussed below, can result in over-estimates or under-estimates of human exposure, exposure is probably over-estimated, overall, for the potentially exposed populations evaluated.

6.2.2.1 Exposure Point Concentrations

The EPCs used in the exposure assessment were estimated without consideration of environmental migration, transformation, degradation, or loss and should generally result in over-estimates of long-term exposure.

EPCs for COPCs in surface water, sediment, and floodplain soil were based on the 95% UCL on the arithmetic average concentration calculated using ProUCL. The number of non-detected chemicals in a data set and the treatment of non-detects in the statistical evaluation of the data (*i.e.,* substitution of the full sample reporting limit) may result in uncertainty in the calculated EPCs for some COPCs. It was generally observed that reporting limits for the same detected chemical could vary by orders of magnitude depending on the investigation, analytical method, and laboratory that performed the sample analysis. Use of combined data sets with variable detection limits for non-detect observations contributes to uncertainty in the calculation of EPCs. As a result, the EPCs may be under-estimated or over-estimated.

In cases where 95% UCL concentrations were greater than maximum detected concentrations, or where a data set consisted of less than four samples or more than 70 percent non-detected observations, the EPC was instead based on the maximum detected concentration. Use of maximum concentrations rather than some other estimate of exposure (*e.g.,* mode, median, or arithmetic average) may over-estimate the potential for average exposure and adverse health effects.

EPCs for fish fillet and shellfish were also based on 95% UCL concentrations, where applicable. However, as described in Section 4.2.1.3, ANCOVA was used to evaluate temporal and spatial patterns in total PCB concentrations and to assist in determining whether data collected at different stations throughout the Study Area were statistically significantly different or not. Based on these comparisons, biota data from locations without statistically significant differences were grouped into a single data set, then EPCs were calculated and applied to multiple EUs. For the most part, EPCs for fish fillet were applied to the EUs from which samples were collected. However, in some cases, biota samples were not collected from a given EU (*e.g.,* crayfish at EUs GB. BB1, and SL), yet EPCs calculated on combined data sets including samples from adjacent EUs were applied. There is uncertainty in modeling exposure to biota at EUs from which sample data are not available, such that the potential for actual exposure may be under-estimated or over-estimated.

6.2.2.2 Human Exposure Scenarios

The human exposure scenarios evaluated in this BHHRA were considered plausible under the current and reasonably anticipated future land uses within the OU4 Study Area. These exposure scenarios are described in USEPA risk assessment guidance and are commonly included in Superfund HHRAs. The human health CSEM (RAGS Part D Table 1) describes how each exposure scenario applies to the Site and OU4 in particular but does not address every potential human exposure that may occur in the Study Area.

The human health CSEM identified the potential for exposure of recreationists/sportsmen/anglers and outdoor workers to COPCs in surface water. Dermal contact exposure to non-volatile COPCs was evaluated in a quantitative assessment, but the potential for exposure to volatile COPCs in surface water was considered unlikely. Rather, it was assumed VOCs would mix with outdoor ambient air and the resultant VOC concentrations in outdoor air would be negligible.

The only volatile COPCs identified in the surface water data set were cis-1,2-DCE and TCE. These VOCs were detected in only 3/11 surface water samples but at the same three sample locations adjacent to and downstream of the former CDE facility (RM6.25, RM6.0, and RM5.3). Sediment porewater samples collected in the same vicinity also contained cis-1,2-DCE and TCE, and maximum detected porewater concentrations were greater than those in surface water. As indicated in Section 4.1.1.3, the maximum cis-1,2-DCE concentration detected in porewater (4,000 µg/L) was orders of magnitude greater than in surface water (8.8 µg/L). Multiple lines of evidence from the OU3 and OU4 investigations strongly suggest groundwater is an on-going source of contamination to porewater, surface water, and sediments in Bound Brook near the former CDE facility (see the OU4 RI Report Section 7). Under the current hydraulic flow regime, it is possible that VOCs not detected in surface water may be present in porewater and eventually discharge to surface water, and where detected in both media, porewater concentrations may be greater than in surface water. The lack of a quantitative assessment to address potential inhalation exposures to VOCs in surface water is a source of uncertainty. However, it is still most likely that VOCs in surface water would mix with outdoor ambient air and the resultant VOC concentrations in outdoor air (to which humans may be exposed) would be negligible.

The human health CSEM identified the potential for construction/utility worker exposure to COPCs in floodplain soil. The evaluation considered a worker who may be exposed to All Soil through incidental ingestion, dermal contact, and inhalation of respirable particulates released during the digging of a trench for construction/utility work. Alternatively, the outdoor worker exposure scenario considered exposure to COPCs in surface water, sediment (All Sediment), and floodplain soil (Surface Soil). This worker was identified as someone who works to maintain, repair, and/or clean culverts, spillways, bridges, and other structures in the OU4 Study Area. Given there are utility lines that traverse Bound Brook and other surface water bodies within the Study Area (*e.g.,* maintenance of a sewer line on Cedar Brook was observed in 2012), there is the potential for construction/utility workers to also be exposed to COPCs in surface water and sediment (All Sediment). The lack of such a quantitative assessment in this BHHRA may be a source of uncertainty.

However, the outdoor worker and construction/utility worker exposure scenarios were effectively the same in terms of exposure duration, frequency, and other parameter values. As described in Section 4.2.3, the only differences in the exposure assessment between the two receptor populations were assumptions regarding the environmental media to which each receptor may be exposed and the potential mechanism by which each receptor population may be exposed to COPCs in outdoor air. In the event that construction/utility work were to occur along or across surface water bodies in the Study Area, the potential for construction/utility worker exposure to COPCs in surface water and All Sediment is expected to be the same as that already estimated for outdoor workers. It is not likely that respirable particulates would be released from wetted sediments, even during the digging of a trench for construction/utility work. Therefore, inhalation exposure of construction/utility workers to particulate COPCs released from All Sediment are not likely, and the potential for adverse health effects in construction/utility workers is not under-estimated by simply deferring to risks and hazards estimated for outdoor workers. As presented in Section 4.4.1.6 for outdoor workers, there may be a potential for unacceptable cancer risk to a construction/utility worker from exposure to benzidine in sediment at EU BB3 and a potential for non-cancer hazard from exposure to total PCB Aroclors in All Sediment and All Soil at EU BB5.

The human health CSEM identified the potential for resident adults and children to be exposed to COPCs in floodplain soil (All Soil). However, the residential exposure scenario was not intended to be an evaluation of actual current/future residential exposures, but instead represented the reasonable maximum exposure that any receptor population accessing the OU4 floodplain areas may have (*i.e.*, it is unlikely anyone using the floodplain areas would have a greater exposure than that associated with residential use). The residential exposure scenario is a conservative assessment and is thereby protective of most other receptor populations as well.

The potential for exposure to floodplain soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Residential soil samples are evaluated on a case-by-case basis by USEPA risk assessors to determine whether remedial actions should be conducted on residential properties. Table 6-1 presents a summary of total PCB concentrations in soil samples collected from residential yards that are located within the geographic boundaries of OU4. As shown, detected concentrations range from 0.005 to 4.8 mg/kg. EPCs for total PCB Aroclors in All Soil ranged from 0.053 mg/kg at EU GB to 62 mg/kg at EU BB6. Generally, the EPCs used to evaluate hypothetical residential exposures to floodplain soil in this BHHRA are greater than the PCB concentrations actually detected in residential soils addressed under OU1.

Lastly, the human health CSEM identified recreationists as potential receptors who may be exposed to COPCs in surface water, sediment, and floodplain soil. The exposure scenario assumed that adults and adolescents (primarily local residents) might recreate throughout the floodplain area and perhaps in and around Bound Brook. The evaluation likely over-estimates the actual potential for exposure of recreationists, specifically in terms of exposure frequency and duration, given the developed nature of the OU4 Study Area. Therefore, an uncertainty evaluation was conducted, to address the potential for adverse health effects in an area where frequent recreational activities are known to occur: Veterans Memorial Park.

The evaluation focuses on total PCB concentrations detected in a subset of surface soil samples collected in and around developed recreational areas at Veterans Memorial Park. These samples were from the baseball field, playground, a mowed recreational field north of the parking lot, grassy areas next to a nature trail outside the park fence, and grassy areas immediately inside the fenceline adjacent to residential properties bordering the park to the east. The surface soil samples were collected during the USEPA's 1999 floodplain soil sampling (Weston Solutions, 2000), the Borough of South Plainfield's SI (PMK Group, 2002), and the OU4 RI. Data from historic samples that were collected in areas of the park that have since been remediated were removed from the evaluation. Total PCB Aroclor concentrations ranged from 0.034 to 21 mg/kg, and a 95% UCL concentration calculated on this data set would be 3.5 mg/kg. In contrast, the EPC used to evaluate recreational exposures to Surface Soil at EU BB4 was 13 mg/kg (RAGS Part D Table 3.25 in Appendix A). Use of the alternate EPC specific to Veterans Memorial Park in the exposure assessment for the recreationist RME scenarios evaluated in this BHHRA results in the following cancer risks and non-cancer hazards for exposure to total PCB Aroclors alone:

- Adult recreationist – cancer risk of 9E-07 and non-cancer HQ of 5E-02.
- Adolescent recreationist – cancer risk of 1E-06 and non-cancer HQ of 2E-01.

The estimated cancer risks are less than or at the lower end of the cancer risk range of 1E-06 to 1E-04 established by the NCP, and the estimated non-cancer HQs are less than the target HQ of 1E+00. Based on this uncertainty evaluation, adverse health effects from exposure to total PCB concentrations detected in Surface Soil samples in and around the developed recreational areas at Veterans Memorial Park are not expected.

6.2.2.3 Exposure Equations and Parameter Values

The greatest cancer risks and non-cancer hazards estimated in this BHHRA were for anglers who consume bottom-feeding fish fillet. The greatest cancer risks were estimated for the combined angler adult/child and ranged from 3E-03 to 2E-02 depending on the EU. The greatest non-cancer hazards were estimated for the angler child and ranged from 2E+02 to 9E+02 depending on the EU. These risk/hazard estimates are largely dependent on the fish fillet ingestion rate of 23.2 g/d, which was assumed for the angler adult and based on a study of fish consumption patterns in Newark Bay (Burger, 2002).[27] This ingestion rate was considered reasonable for the OU4 Study Area and may reflect the fish consumption rate for people who eat their catch. However, almost all (37/38) of the anglers surveyed in 2012 reported that they never keep or eat their catch. Twenty-six respondents reported they had seen the Fish Advisory warning signs. While the informal angler survey does not represent all anglers in the Study Area (*e.g.,* fishing during weekday evenings and weekends was not surveyed), it is possible that the majority of fishing that occurs in and near Bound Brook is for recreational purposes only and limited consumption of recreationally-caught fish actually occurs.

This BHHRA assumed that anglers consume only either predatory fish fillet or bottom-feeding fish fillet, but not both. Cancer risks for the combined angler adult/child exposed to COPCs in predatory fish fillet were less than those estimated for bottom-feeding fish fillet and ranged from 3E-04 to 5E-03. Based on the assumptions (*e.g.,* ingestion rates) used to evaluate the RME scenario, it can be deduced that estimated cancer risks for an adult angler who consumes fish fillet (regardless of type) range from 3E-04 to 2E-02. Non-cancer hazards for the angler child exposed to COPCs in predatory fish fillet ranged from 8E+00 to 2E+02. Therefore, based on the assumptions used to evaluate the RME scenario, it can be deduced that non-cancer hazards for an angler child who consumes fish fillet (regardless of type) range from 8E+00 to 9E+02.

This BHHRA also assumed that anglers consuming shellfish ate only Asiatic clams or crayfish, but not both. Based on the assumptions (*e.g.,* ingestion rates) used to evaluate the RME scenarios, it can be deduced that estimated cancer risks for an adult angler who consumes shellfish (regardless of type) range from 6E-05 to 4E-03, and non-cancer hazards for an angler child who consumes shellfish (regardless of type) range from 4E-01 to 6E+00.

Further, this BHHRA assumed that anglers consume only either fish fillet or shellfish, as risks/hazards from consumption of fish fillet and shellfish were not additive. This is a reasonable assumption for the OU4 Study Area, as the study on fish consumption in the Newark Bay area indicated “most people either fished or crabbed, but not both” (Burger, 2002). Cancer risks and non-cancer hazards were estimated separately for each type of

[27] The fish fillet ingestion rate for angler children was 7.75 g/day, calculated assuming 1/3 of the angler adult ingestion rate.

fish fillet (*i.e.,* predatory or bottom-feeding) and shellfish (*i.e.,* Asiatic clams or crayfish) to evaluate the potential for adverse health effects in anglers who consume for example, only locally-caught catfish or only locally-caught Asiatic clams at the ingestion rates assumed for fish fillet or shellfish, as applicable. To the extent that an angler consumes both fish fillet and shellfish, such that the total ingestion rate exceeds either or both of those used to evaluate exposure to COPCs in locally-caught biota, the risks and hazards presented in this BHHRA may be under-estimated.

Lastly, under the RME scenarios evaluated for anglers, no COPC losses due to preparation method (*e.g.,* skin on fillet, skin off fillet, whole fish), cooking method (*e.g.,* dripping and volatile losses), or post-cooking processes (*e.g.,* cutting, excess fat, bones, scraps, and juices) were assumed in estimating intake of COPCs from fish fillet or shellfish. In other words, the cooking loss parameter (*i.e.,* CL) value used in the intake equation was zero. This default assumption is appropriate for estimating exposure to metals detected in biota, as the USEPA (2000d) indicates that, in most cases, preparation and cooking loss adjustments should not be applied for metals. However, intakes of organic COPCs in fish fillet and shellfish may be over-estimated. Therefore, to evaluate angler exposures under CTE scenarios, CL factors were applied to effectively "convert intake rates to those that are representative of foods 'as consumed'" (USEPA, 2011).

For fish and shellfish, USEPA (2011) recommends default adjustments of 31.5 percent for preparation and cooking losses and 10.5 percent for post-cooking loss. A default CL value of 0.61 [*i.e.,* (1-0.315) x (1-0.105)] was calculated using an equation provided in USEPA, 2011. This default CL value was used in the intake calculation for organic COPCs other than PCBs (*i.e.,* pesticides). For PCBs and TCDD TEQ (PCBs), a CL value of 0.80 was used, assuming an approximately 20 percent loss. This CL value is based on that used in the HHRA for the Hudson River (TAMS Consultants and Gradient Corporation, 2000), in which a variety of studies were evaluated. Cooking losses for PCBs ranged from 0 to 74 percent with most between 10 and 40 percent; 20 percent was selected presumably as the midpoint between 0 and 40 percent (TAMS Consultants and Gradient Corporation, 2000).

These CL values, combined with other CTE parameter values used in the intake equation, reduced the cancer risks and non-cancer hazards estimated for anglers under the RME scenario. For example, the greatest cancer risk (2E-02), which was estimated for combined adult/child angler consumption of bottom-feeding fish fillet at EU BB5, was reduced to 5E-03. The greatest-noncancer HI (9E+02), which was estimated for angler child consumption of bottom-feeding fish fillet at EU BB5, was reduced to 7E+02.

6.2.3 Available Toxicity Values

The derivation of the toxicity values that form the basis of the risk characterization can result in over- or under-estimates of the potential for adverse health effects. In most cases, the toxicity values are derived from extrapolation from laboratory animal data to humans. As indicated in RAGS Part D Tables 5.1 and 5.2, the oral RfDs and inhalation RfCs contain modifying and/or uncertainty factors that range from 1.5 to 3,000.

RfDs and cancer slope factors for oral exposure were adjusted and used to assess risks from dermal absorption. While this adjustment follows USEPA guidance, oral absorption for the organic COPCs was assumed to be 100 percent which may under-estimate dermal contact exposure for some chemicals. For those chemicals with specific oral absorption factors, consideration was not given to the absorption efficiency of the exposure vehicle used in the studies on which the factors are based. This may over-estimate or under-estimate dermal contact risks for some chemicals.

Finally, for some chemicals, health criteria are insufficient to determine RfDs or slope factors for oral and/or inhalation exposure. As a result, the potential for risk may be under-estimated. Toxicity values (*i.e.*, RfDs, RfCs, cancer slope factors, and unit risk factors for assessing oral and inhalation exposure) were not available for the following COPCs: acenaphthylene, benzo(g,h,i)perylene, phenanthrene, carbazole, 1.3-dichlorobenzene, dimethyl phthalate, di-n-octyl phthalate, p-isopropyl toluene, delta-BHC, endosulfan sulfate, endrin aldehyde, and endrin ketone. A brief summary of adverse health effects associated with exposure to each of these chemicals is presented in Section 6.2.4 below.

At the present time, scientists with the USEPA's IRIS Program are evaluating the toxicity of some chemicals that were identified as COPCs in various environmental media, including arsenic, benzo(a)pyrene, cadmium, cobalt, copper, 1,3-dichlorobenzene, bis(2-ethylhexyl)phthalate, dioxin, nickel, phthalates (cumulative), PCBs (non-cancer), and PAH mixtures (see IRIS Track at www.epa.gov/iris). This may result in modification to the toxicity values used in this BHHRA. Therefore, the toxicity values used herein may result in either an under-estimate or over-estimate of cancer risk and non-cancer hazard.

6.2.4 Qualitative Evaluation of COPCs without Toxicity Values

For some chemicals, toxicity studies are insufficient to determine RfDs/RfCs or slope factors/unit risk factors for oral and/or inhalation exposure. As a result, the cancer risks and non-cancer HIs may be under-estimated.

Toxicity values were not available for the following COPCs: acenaphthylene, benzo(g,h,i)perylene, phenanthrene, carbazole, 1,3-dichlorobenzene, dimethyl phthalate, di-n-octylphthalate, p-isopropyltoluene, delta-BHC, endosulfan sulfate, endrin aldehyde, and endrin ketone. While cancer risks and non-cancer hazards were not quantified, possible health implications that may be associated with exposure to these chemicals can be found in other USEPA sources (2012e), in ATSDR Toxicological Profiles (as available) obtained from the following website: http://www. atsdr.cdc.gov/toxpro2.html, or in the National Institutes of Health online toxicology database at the following website: http://toxnet.nlm.nih.gov/.

- Acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.[28] These three chemicals are among the 17 PAHs typically analyzed for and evaluated at hazardous waste sites. The 17 PAHs often occur together in the environment and many have similar environmental fate and toxicological characteristics (ATSDR, 1995). However, reliable environmental fate and toxicological information exists for only a few of the 17 PAHs, and the potential health effects of the other less well-studied PAHs must be inferred from this information (ATSDR, 1995). The USEPA (2012a) weight-of-evidence characterization for all three chemicals is "D - not classifiable as to carcinogenicity" based on no human data and inadequate animal data. The three chemicals were detected in sediment and floodplain soil.
- Carbazole. Carbazole is an aromatic heterocyclic organic compound that is released to the environment via atmospheric emissions from waste incineration, aluminum manufacturing, and combustion of organic materials (*e.g.*, rubber, petroleum, coal, and wood) (NIH, 2012). Carbazole is not classifiable as to its human carcinogenicity. Liver and GI tract effects were reported in animal studies of chronic exposure to carbazole (NIH, 2012). This chemical was detected in sediment and floodplain soil.

[28] An ATSDR Toxicological Profile for PAHs is available from August 1995.

- 1,3-Dichlorobenzene.[29] 1,3-Dichlorobenzene.[1] 1,3-Dichlorobenzene contains two chlorine atoms connected to one benzene ring and is used to make herbicides, insecticides, medicine, and dyes (ATSDR, 2006b). Liver, thyroid, and pituitary effects have been reported in animal studies of chronic exposure to1,3-dichlorobenzene (ATSDR, 2006b). The USEPA (2012a) weight-of-evidence characterization is “D - not classifiable as to carcinogenicity” based on no human data and inadequate animal data. 1,3-Dichlorobenzene was detected in sediment.
- Dimethyl phthalate. Dimethyl phthalate is the methyl ester of phthalic acid and is used in solid rocket propellants, plastics, and pesticides (USEPA, 2012e). Effects on growth and on the kidney have been reported in animal studies of chronic oral exposure to dimethyl phthalate (USEPA, 2012e). The USEPA (2012a) weight-of-evidence characterization is “D - not classifiable as to carcinogenicity” based on no human data and inadequate animal data. Dimethyl phthalate was detected in floodplain soil.
- di-n-Octyl phthalate.[30] di-n-Octyl phthalate is commonly used in plastics and is also used in cosmetics and pesticides (ATSDR, 1997). No information on the possible human toxicity of di-n-Octyl phthalate is available; however, liver effects have been reported in animals exposed via the oral route of exposure (ATSDR, 1997). An MRL protective of adverse effects on the liver is available (ATSDR, 2012). di-n-Octyl phthalate was detected in sediment and floodplain soil.
- di-n-Octyl phthalate.[31] di-n-Octyl phthalate was detected in sediment and floodplain soil.
- p-Isopropyltoluene (p-Cymene). p-Isopropyltoluene is a naturally occurring organic compound that has also been produced and used as a solvent and in the flavor and fragrance industry (NIH, 2012). p-Isopropyltoluene is a primary skin irritant in occupational workers exposed via dermal contact, although the general public is more likely to be exposed via inhalation and consumption of foods that naturally contain p-isopropyltoluene (NIH, 2012). TOXNET indicates the potential toxicity of p-isopropyltoluene is similar to that of toluene (NIH, 2012). Adverse effects on the kidney and nervous system are associated with chronic

[29] An ATSDR Toxicological Profile for dichlorobenzenes is available from August 2006.
[30] An ATSDR Toxicological Profile for di-n-octyl phthalate is available from September 1997.
[31] An ATSDR Toxicological Profile for di-n-octyl phthalate is available from September 1997.

exposure to toluene (USEPA, 2012a). p-Isopropyltoluene was detected in sediment.

- delta-BHC.[32] delta-BHC is one of eight isomers of the insecticide hexachlorocyclohexane (also called benzene hexachloride). While the toxicity of the isomers varies, all of them can produce liver and kidney effects (ATSDR, 2005). The USEPA (2012a) regards hexachlorocyclohexane as a possible human carcinogen based on increases in benign liver tumors in mice fed beta-HCH. Delta-BHC was detected in sediment.
- Endosulfan sulfate.[33] Endosulfan sulfate is a reaction product found in technical endosulfan, a man-made insecticide, as a result of oxidation in nature, biotransformation, or photolysis. The only studies of longer term exposure to low concentrations of endosulfan are in animals. These animal studies indicate the kidneys, testes, and possibly the liver were affected (ATSDR, 2000). Endosulfan has not been classified by the USEPA with regard to its ability to cause cancer. The limited animal studies have not shown evidence of carcinogenicity. However, some of the animal studies have shown endosulfan can cause damage to genetic material within cells (ATSDR, 2000). Endosulfan sulfate was detected in sediment and floodplain soil.
- Endrin aldehyde and endrin ketone.[34] Endrin aldehyde is an impurity and breakdown product of endrin, which was used as a pesticide. Endrin ketone is a product of endrin when it is exposed to light. There are no known adverse health effects based on long-term exposure to workers who have been exposed to endrin. Animal studies indicate the nervous system is likely the main toxic endpoint (ATSDR, 1996). The USEPA (2012a) classifies endrin as “D - not classifiable as to human carcinogenicity” based on animal studies in rats and mice. Endrin aldehyde was detected in sediment, floodplain soil, and fish tissue, while endrin ketone was detected in sediment and floodplain soil.

[32] An ATSDR Toxicological Profile for hexachlorocyclohexane is available from August 2005.
[33] An ATSDR Toxicological Profile for endosulfan is available from September 2000.
[34] An ATSDR Toxicological Profile for endrin is available from August 1996.

6.3 ERA Uncertainty

6.3.1 Problem Formulation

Uncertainties associated with problem formulation include the accuracy of the CSEM developed to focus the ERA and the appropriateness of the selected assessment and measurement endpoints. The CSEM for this ERA, which was based on environmental information from the Study Area and professional judgment, was consistent with the earlier ecological risk assessment work conducted by the USEPA. The assessment endpoints addressed the important components of aquatic and terrestrial systems and the variety of measurement endpoints for each component provided a multiple lines of evidence approach deemed adequate for evaluating the potential for adverse health effects. While reptiles and amphibians are identified as potential wildlife receptors within the OU4 Study Area, the potential for adverse effects on reptile and amphibian populations was not evaluated quantitatively due to the general lack of readily available information on metabolism and toxicity in these potential receptors. Reptiles and amphibians may make up a considerable percentage of the diets of many wildlife receptors. Amphibians are known to be sensitive indicator species for stressors in the environment. The 1997 Ecological Evaluation (USEPA, 1999a) set out to collect frogs for a bioassay, but sufficient numbers of frogs could not be collected. The potential for adverse effects to these receptors within the OU4 Study Area is unknown.

6.3.2 Exposure and Effects Analysis

The exposure and effects analysis also relies on a series of assumptions regarding the potential for exposure of ecological receptors, as outlined in Table 5-2 and approximated in the various comparisons of environmental data to protective screening concentrations and in the wildlife intake calculations. The ERA attempted to address some of the uncertainty in these assumptions by conservatively evaluating the potential for adverse health effects in each of the evaluated scenarios. The analysis primarily relied on USEPA default exposure assumptions with appropriate modification for site-specific conditions. Once again, the intention is to over-estimate the potential for adverse health effects, so the actual hazards are less than those predicted in this ERA.

Surface Sediment (*i.e.*, 0-15 cm) and Surface Soil (*i.e.*, 0-30 cm) data sets were selected based on depth. Other physical (*e.g.*, grain size, organic carbon, rooting depth) or chemical (*e.g.*, pH, redox potential) parameters were not considered in selecting the sediment and soil data sets. Because the biologically active zone for organisms in sediment may be limited to only a few centimeters (Suter, 2007), exposure point concentrations representative of the top 0 to 15 cm may over-estimate or under-estimate the potential for adverse health effects. The top 30 cm of floodplain soil, generally considered a default depth for evaluating plant and earthworm exposures (Suter, 2007), was selected to evaluate not only terrestrial plant and invertebrates exposure but also birds and mammal exposure. Therefore, the potential for adverse health effects for any organisms exposed to deeper floodplain soil, such as burrowing mammals, may be over-estimated or under-estimated.

As with the HHRA, the number of non-detected chemicals in a data set and the treatment of non-detects in the statistical evaluation of the data (*i.e.*, substitution of the full sample reporting limit) may result in uncertainty in the calculated EPCs for some COPECs. As a result, the EPCs may be under-estimated or over-estimated. The EPCs used in the exposure and effects analysis (*i.e.*, the 95% UCL on the arithmetic average concentration or the maximum detected concentration) were estimated without consideration of environmental migration, transformation, degradation, or loss and could result in over-estimates of long-term exposure.

COPECs were selected for evaluation in the ERA through a two-step process involving screening-level evaluation and refinement. The intent was to focus the ERA on those chemicals that pose the greatest potential for accumulation in wildlife and adverse health effects. Uncertainty in the selection process, which was generally based on the available environmental data and ecological screening levels, relates to the extent to which the data characterizes environmental conditions within the Study Area and the lack of screening levels for some detected chemicals. The elimination of chemicals that were not detected or detected in less than 5 percent of samples (for samples sizes greater than 20) may result in an underestimation of risk. Other detected chemicals were not evaluated further in the ERA, due to their either being screened out or lack of screening levels. However, although these chemicals may contribute to the overall potential for adverse health effects, their contribution is expected to be relatively small compared to those of the COPECs evaluated in the ERA.

During the COPEC selection process, as summarized in Table 5-8, PCBs were selected as a COPEC in Surface Sediment indicating the potential for adverse effects in benthic invertebrates. Benthic invertebrates are generally insensitive to PCBs with dioxin-like toxicity due to the lack of aryl hydrocarbon receptor (AHR), the biological binding and activation site through which dioxin-like toxic effects are mediated (USEPA, 2008c).

However, crustaceans and younger developmental stages of aquatic organisms have been documented as some of the most sensitive receptors in aquatic systems (Eisler, 1986). Benthic invertebrates may experience other non-dioxin-like toxicological effects. For example, endocrine effects observed in invertebrates do not occur via an AHR-mediated pathway (Henry and DeVito, 2003).

Vinyl chloride was detected in Surface Sediment only at EU BB5 and at a concentration greater than the ESV, with a refined HQ greater than 1. The ESV for vinyl chloride is a USEPA Region 5 ecological screening level, which was based on the equilibrium partitioning approach developed by USEPA (Di Toro et al., 1991). cis-1,2-DCE was detected in Surface Sediment at EUs BB3 through BB6 and SL and was retained as a refined COPEC due to the lack of an ESV.

The standard equilibrium petitioning approach uses the mass fraction of organic carbon in sediment (foc) and the chemical-specific partition coefficient between water and organic carbon (Koc) to calculate sediment quality benchmarks as follows:

$$SQB = WQB\ x\ Koc\ x\ foc$$

Where:

SQB = Sediment quality benchmark (mg/kg);
WQB = Water quality benchmark (mg/L);
foc = Fraction of sediment present as organic carbon (unitless); and
Koc = Organic-carbon/water partition coefficient (L/kg)

This approach assumes that the bioavailable fraction of nonionic organic chemicals is equivalent to the fraction of the sediment concentration that is freely dissolved in interstitial water, and that the freely dissolved fraction is determined primarily by the extent of partitioning to organic carbon. The applicability of the equilibrium partitioning approach to nonionic organic chemicals has been extensively validated by the USEPA (2003a; 2003b). However, the original equilibrium partitioning equation (provided above) is ineffective for assessing less-hydrophobic organic chemicals in sediment (like cis-1,2-DCE and vinyl chloride), because it fails to account for the contribution of dissolved chemical to the total chemical concentration in sediment. Because these VOCs are less strongly hydrophobic than the chemicals for which the equilibrium partitioning approach was originally developed, a modification of the equilibrium partitioning approach developed by Fuchsman (2003) can be employed. The following equilibrium partitioning equation corrects for the dissolved fraction of total chemical concentrations in sediment (Fuchsman, 2003) and this equation was used to calculate modified sediment quality benchmarks for cis-1,2-DCE and vinyl chloride:

$$SQB = WQB \times \left[\left(f_{OC} \times K_{OC} \right) + \left(\frac{1 - f_{solids}}{f_{solids}} \right) \right]$$

Where:

f_{solids} = Fraction of sediment present as solids (unitless).

The Koc values were obtained from the USEPA EPISuite program (Version 4.1). Site-specific organic carbon and solids content for sediment samples collected within EU BB5 were used. The identification of the WQB is described below.

In the absence of state surface water quality standards, criteria, or benchmarks, the following USEPA Region 5 surface water ESLs were used as the WQBs.

The SQB was then calculated using these inputs and the modified equilibrium partitioning equation (Fuchsman, 2003) (provided above). The SQBs for cis-1,2-DCE and vinyl chloride are presented below.

	K_{oc}	Fraction solids	Fraction organic carbon	USEPA Region 5 Surface Water ESL	Modified SQB
Chemical	L/kg	(unitless)	(unitless)	(µg/L)	(mg/kg)
cis-1,2-Dichloroethene	39.6	0.5	0.01	590	0.8
Vinyl Chloride	21.73	0.5	0.01	930	1

Based on HQs calculated using these modified SQBs the concentrations of vinyl chloride in Surface Sediment are not expected to present an ecological risk at EU BB5. However, while the concentrations of cis-1,2-DCE in Surface Sediment at EUs BB3, BB4, and SL are below the modified SQB, the concentrations in 3 of 24 surface sediment samples (ranging from 2.3 to 61 mg/kg) at EU BB5 exceed the modified SQB. Therefore, the potential for adverse health effects in benthic invertebrates from exposure to cis-1,2-DCE is likely localized in areas of EU BB5. This evaluation of uncertainty serves to refine the evaluation of benthic invertebrate exposure to VOCs as it takes into account relative bioavailability. Detected concentrations of cis-1,2-DCE in porewater exceeding ESVs confirms this assessment and porewater concentrations are better predictors of toxicity in benthic organisms (Di Toro et al., 1991; USEPA, 2000a).

The estimates of COPEC intake by aquatic and semi-aquatic ecological receptors was based on available site-specific fish and invertebrate tissue data. While this approach is less uncertain than using, for example, measured sediment data and biota-sediment accumulation factors from the literature to estimate COPEC concentrations in prey organisms, a number of simplifying assumptions contribute to uncertainty. These include combining tissue data for different fish species into two broad categories of fish (predatory and bottom-feeding), combining tissue data for Asiatic clams and crayfish into one broad "invertebrate" category, and assuming these fish and invertebrates are representative of actual prey organisms preferred and consumed by the ecological receptors evaluated. Such an approach may have masked higher COPEC concentrations in certain prey organisms and does not account for other prey organisms that may be preferred/consumed. However, wildlife exposures are likely to vary throughout the year depending on the availability/abundance of prey and changing dietary preferences.

Estimates of COPEC intake by terrestrial herbivores were based on estimated COPEC concentrations in terrestrial plant tissue using literature-derived soil-to-plant BAFs. The use of these generic BAFs introduces some uncertainty into the resulting risk estimates, which may lead to over- or underestimation of the potential for adverse effects in herbivores. Because plant uptake of PCBs is considered to be negligible due to the large molecular weight and strong sorption of PCBs to organic matter (Bacci and Gaggi, 1985), PCB uptake into plants may be over-estimated. The values selected and methodology employed was intended to provide a reasonable estimate of plant tissue concentrations within the OU4 Study Area.

Like that described previously for the HHRA, EPCs for whole body fish tissue and small mammals tissue, as well as the Asiatic clam and crayfish tissue consisted of combined datasets based on the statistical evaluation presented in Appendix E. Based on available biota datasets, samples for the various tissue types were lacking in the following EUs:

- no whole body fish tissue data from EUs GB or BB1,
- no Asiatic clam tissue data from EUs GB, BB1, BB2, or SL,
- no crayfish tissue data from EUs GB, BB1, or SL, and
- no small mammal tissue data were available from EUs GB, BB1, BB2, or BB6.

However, biota data from other EUs were combined, based on the statistical evaluation, and applied to these EUs for which data were lacking. There is uncertainty in dietary exposure modeling for EUs from which tissue data are not available, such that the potential for actual exposure may be under-estimated or over-estimated.

Published exposure parameter values (*e.g.*, body weight, food and water ingestion rates) and percent dietary composition (*e.g.*, percent invertebrates) were used to estimate COPEC intakes by representative adult wildlife receptors. Since these values and percentages were assumed to be appropriate for the Study Area, actual COPEC intakes by wildlife in the Study Area, including adults and earlier life stages, may be under- or over-estimated. For example, American mink were assumed to consume 88 percent fish and 12 percent invertebrates based on a study in stream habitats (Alexander, 1997). However, as documented by USEPA (1993b), mammals (*e.g.*, muskrat) can be the most important prey in the year-round diet of mink in certain areas within their range. Therefore, dietary exposure for the American mink may be over-estimated. The home ranges for the mallard (303 ha), red-tailed hawk (624 ha), and red fox (737 ha) are larger than the areas of the individual exposure units (from BB2 = 30 ha to BB1 = 147 ha) indicating that these wildlife might accumulate COPECs from other exposure units or even from outside the Study Area. Thus, evaluating these wildlife on an exposure unit-by-exposure unit basis may over- or under-estimate the potential for COPEC intake and adverse health effects.

Conservative screening levels for the environmental media evaluated and CBRs for invertebrate and fish tissues and fish and bird egg residues were used such that the potential for adverse health effects in these organisms may be over-estimated. In selecting CBRs, consideration was generally given to the most sensitive species, potentially toxic effect, and toxicity measure. Measured tissue or estimated residue

COPEC concentrations were compared to CBRs based on both LOAEL and NOAEL endpoints, to reduce uncertainty by bounding the potential for adverse health effects. However, it must be noted that while accumulation of COCs in the tissues of benthic invertebrates provides direct evidence of bioavailability, bioaccumulation alone is not an indication of adverse health effects.

The tissue evaluation assumed that whole body residue is a useful surrogate measurement of the amount of chemical at the site of toxic action within the organism, and therefore, toxic responses can be predicted from whole body concentrations (USEPA, 2000a). CBRs were selected from literature-derived whole body measures for mortality (survival), growth, and reproduction effects from studies on freshwater species (Appendix I). However, CBRs may not be an accurate predictor of actual site-related adverse health effects.

For example, while fish health metric studies or community surveys were not conducted during the OU4 RI, a fish health metric (*i.e.*, fish condition factor) was calculated based on the historical fish data and used in the ERA. The fish condition factor (FCF), a measure of the relative fish robustness or degree of well-being (Williams, 2000), is calculated as follows:

$$FCF=(100{,}000 \times W)/L^3$$

Where:

FCF = Fish condition factor
W = Weight of the fish in grams
L = Length of the fish in millimeters

For fish growing isometrically (*i.e.*, weight is increasing as the cube of the length), the FCF will be close to 1.0. More robust fish will have FCFs greater than 1 and fish that are undernourished will have FCFs less than 1.0. The length and weight data for fish collected during the USEPA 1997 Ecological Evaluation and the 2008/2009 Reassessment and the calculated FCFs are shown in Table 6-2. As shown in Table 6-2, FCFs are generally equal to or greater than 1 for fish in all EUs, indicating fish within the OU4 Study Area appear to be healthy.

The fish CBRs from Steevens et al. (2005) were for TCDD TEQ only. While fish are generally sensitive to PCBs, with the most sensitive endpoints being reproduction and early life stage, they are generally insensitive to the PCB congeners with a single chlorine substitution in an ortho position on the biphenyl molecule (USEPA, 2008c). These congeners are known as the mono-*ortho*-substituted PCB congeners. Eight of the 12 congeners evaluated in the toxicity equivalency weighting scheme are mono-*ortho* substituted. Fish insensitivity to the mono-*ortho* substituted congeners is demonstrated in the low HQs.

Several bird species have been found to be sensitive to PCB congeners with dioxin-like toxicity. The most sensitive effect is embryo mortality, which can vary by 200-fold (USEPA, 2008c). Birds are much more sensitive to the mono-*ortho*-substituted PCB congeners (USEPA, 2008c), which were many of the detected congeners in fish tissue. This is demonstrated in the high HQs. While the selected bird egg CBRs were based on studies in ecologically relevant species [*i.e.*, black crowned night heron for total PCB Aroclors and wood duck for TCDD TEQ (PCBs)], there is still considerable uncertainty in the literature-derived CBRs,

While aspects of the exposure and effects analysis methodology can result in over-estimates or under-estimates of exposure of ecological receptors, exposure is probably over-estimated, overall, for the potentially exposed ecological receptors evaluated.

Sediment toxicity tests provided a line of evidence for evaluation of the potential for adverse health effects in benthic invertebrates. While providing useful information, the tests, which included acute and chronic exposures to two test organisms, were a one-time event conducted at a small number of representative locations. Some of the uncertainty associated with these tests relates to whether the test results accurately reflect environmental conditions in the Study Area, the extent to which sediment toxicity is associated with COPECs, and to the extent they may vary over time.

6.3.3 Available Toxicity Values

There is also some uncertainty in the toxicity data used to derive the TRVs used to assess the potential for adverse health effects in wildlife, for a variety of reasons. These include extrapolating test results on laboratory animals in controlled environments to wildlife in the natural environment. In selecting TRVs, consideration was generally given to the most sensitive species and potentially toxic effect. Estimated COPEC concentrations in wildlife were compared to TRVs based on both LOAEL and NOAEL endpoints, to reduce uncertainty by bounding the potential for adverse health effects. However, these uncertainties were minimized by selecting the most appropriate test species for which suitable toxicity data were available. For example, the mammalian TRV for mink selected was from a study (Halbrook et al., 1999) conducted on mink fed field contaminated fish from a riverine system with weathered, higher chlorinated PCBs in sediment. Uncertainties associated with the TRVs for bioaccumulative metals include the fact that most toxicological studies on which the ingestion screening values for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Because intakes were based on total metals, regardless of form, and the highly bioavailable forms are expected to compose only a fraction of the total metal concentrations, potential risks for these metals are likely to be over-estimated. Finally, no TRVs were available for 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, or tetrachloroethene. Therefore, although these chemicals were selected as refined COPECs in Surface Sediment for evaluation of herbivorous semi-aquatic receptors, the potential for adverse effects for these receptors may be underestimated.

6.3.4 Qualitative Evaluation of COPECs without Toxicity Values

Risk associated with a number of chemicals could not be quantitatively evaluated due to the lack of toxicity values (*i.e.*, ESVs). For many of these chemicals little is known about their environmental fate, transport, and/or toxicity. Because there is no way to quantitatively evaluate these chemicals, the impact on ecological risk within the OU4 Study Area is unknown. The overall impact of not retaining chemicals without ESVs as COPECs is considered minimal. However, the exclusion of chemicals that could not be quantitatively evaluated adds to the uncertainty in the overall conclusions. The extent and magnitude of this uncertainty are unknown.

The mechanisms of ecotoxicity for chemicals vary depending on a wide range of factors, such as chemical concentration, the exposed ecological receptor species, the exposure route (*e.g.*, ingestion or direct contact), and physical factors (*e.g.*, pH, temperature, oxygen levels). Some of the effects that could be observed in ecological receptors are mortality, reduced reproductive ability, decreased fertility, decreased offspring survival, alteration of immune and behavioral function, decreased hatching success of eggs/larvae, and retarded growth (Sample et al., 1996). COPECs without toxicity values are listed in Table 5-8. The following provides qualitative discussion of the potential for toxicity associated with exposure to general classes chemicals for which no ESVs are available.

The following descriptions of chemical mechanisms of toxicity are presented without consideration of chemical concentrations, as the descriptions seek to convey an understanding of possible effects rather than describe the concentrations at which these effects might occur.

6.3.4.1 Volatile Organic Compounds

VOCs tend to attenuate rapidly in surface water, sediment and surface soil due to their inherent volatility. Although the effects of VOCs on wildlife are not well understood, there have been extensive studies of the effects of VOCs under laboratory conditions. Inhaled volatile organics are typically metabolized in the body (often the liver), which may cause liver damage (depending on the organism) or the release of more toxic secondary metabolites. The VOCs or their metabolites may also cause neurological damage, and many are mutagenic or carcinogenic. Additionally, some VOCs are fetotoxic and/or teratogenic. Some VOCs, such as acetone, methyl ethyl ketone (2-butanone), methylene chloride, toluene, and the phthalate esters [*e.g.*, bis(2-ethylhexyl)phthalate], are common laboratory contaminants which may be introduced into a sample from laboratory cross-contamination (USEPA, 1989).

6.3.4.2 Semi-Volatile Organic Compounds

SVOCs include a wide variety of chemical classes, such as phenols and phthalates. Semi-volatile chemicals vary greatly in regard to their toxicity (particularly the mechanisms), bioaccumulative potential, and an organism's ability to metabolize them. SVOCs or their metabolites may cause hepatic effects and neurological damage, and many are mutagenic, carcinogenic, fetotoxic, and/or teratogenic (Newman, 1998; Sample et al., 1996).

6.3.4.3 Pesticides

By design, pesticides are toxic to targeted organisms and, as unintended consequence, may also be toxic to many untargeted organisms. Most of the pesticide COPECs without ESVs are organochlorine pesticides (*i.e.*, aldrin, chlordane, dieldrin, endrin, endosulfan, and heptachlor). In general, these pesticides are persistent in the environment, with low aqueous solubilities and high affinity for particulates and organic matter. Being lipophilic they readily bioaccumulate in terrestrial and aquatic food webs. Toxicity to the organochlorine pesticides varies, likely depending on their ability to be metabolized. For example, chlordane can be metabolized to form a number of different metabolic products including heptachlor and heptachlor epoxide, which may be more toxic than chlordane itself. However, all of the organochlorine pesticides act through a central nervous system mechanism, with dietary exposure considered the most important route (Elliott and Bishop, 2011).

Acute toxicity of organochlorine pesticides to aquatic organisms has long been recognized with many studies noting the rapid death of sensitive organisms at relatively low tissue concentrations and the accumulation of higher residues in the remaining resistant organisms (Beckvar and Lotufo, 2011).

Signs of chlordane intoxication in birds include sluggishness, drooped eyelids, fluffed feathers, low crouching on perch, reduced food intake, and weight loss. Later, afflicted animals were observed to rest on their breasts, wings spread, quivering and panting rapidly, back arched, neck arched over the back, and convulsing (Stickel et al., 1983).

Chlordane toxicity in mammals is often realized as labored respiration, muscle tremors, incoordination, convulsions, and sometimes death. Lifetime exposure studies in mice fed low levels of chlordane in their diet indicated development of liver cancer (ATSDR, 1994).

6.3.4.4 Metals

Many trace metals (*e.g.*, cobalt, chromium, copper, iron, manganese, nickel, molybdenum, selenium and zinc) are important in plant and animal nutrition, but the optimal concentration ranges are usually narrow (Leland and Kuwabara, 1985). Imbalances in the essential trace metals may cause a decrease in photosynthetic ability, poor spawning/hatching success, teratogenesis, susceptibility to predation and disease, reduced growth, mortality, histopathological changes, organ dysfunction of the liver or kidneys, neurological defects, changes in respiration and osmoregulation, and anemia.

Naturally occurring metals may cause adverse effects when exposure occurs at concentrations that significantly exceed background concentrations. Metals bioavailability and toxicity are dependent on their differing toxicological properties and also their chemical state (*e.g.*, free ion form, organic complexes, inorganic salts). The toxicity and effects of trace metals in sediment/soil may be greatly influenced by pH and organic carbon content of the sediment/soil in which they occur (USEPA, 2007i), and by the pH, hardness, and organic carbon content of the water in which they occur (Leland and Kuwabara, 1985).

Mechanisms of toxicity of metals to plants tend to depend on the nature of the reactivity of the metal itself (Efroymson et al., 1997a). Metals may alter or inhibit enzyme activity, interfere with deoxyribonucleic acid (DNA) synthesis or electron transport, or block uptake of essential elements. Little is known about mechanisms of toxicity of metals in earthworms (Efroymson et al., 1997b). Metals have various modes of action regarding their toxic properties to mammals, birds and fish. Metals can cause histopathological damage to aquatic organisms' gill secondary lamellae, thereby adversely affecting respiration (Sorensen, 1991).

6.3.4.5 Cyanide

Hydrogen cyanide and its simple salts are highly toxic following acute exposure by experimental animals and both aquatic and terrestrial wildlife. Cyanide mainly effects the central nervous system. Reproductive effects were also observed in rats and mice following drinking water exposure (ATSDR, 2006a). Data on the acute toxicity of free cyanide (the sum of cyanide present as hydrogen cyanide and cyanide anion, expressed as cyanide) are available for a wide variety of freshwater species that are involved in diverse community functions. While simple cyanide compounds do not bioaccumulate, there is evidence suggesting cyanide metal complexes bioconcentrate in fish (ATSDR, 2006a).

7 Conclusions

The primary Site-related contaminants are PCBs and chlorinated VOCs. This risk assessment confirmed that there is a potential for adverse human and ecological health effects from exposure to total PCB concentrations that is relatively wide-spread throughout the OU4 Study Area. The potential for non-cancer hazard from human exposure to total PCB Aroclors in sediment is limited to EU BB5, but total PCB Aroclors in floodplain soil, fish fillet, or shellfish was the predominant contributor to a non-cancer HI greater than 1 for at least one receptor population at every EU. When evaluated as TCDD TEQ, PCBs in fish fillet or shellfish was the predominant contributor to an unacceptable cancer risk or non-cancer hazard for at least one receptor population at every EU. The ERA indicated there is a potential for adverse health effects in ecological receptors from exposure to total PCBs in surface water, porewater, sediment, floodplain soil, and biota at every EU.

The BHHRA did not indicate a potential for adverse human health effects from exposure to chlorinated VOCs. However, the ERA concludes there is a potential for adverse health effects in ecological receptors from exposure to cis-1,2-DCE in porewater and sediment at EU BB5.

The remainder of Section 7 presents conclusions drawn specifically from the BHHRA or ERA and addresses the potential for adverse health effects in human and ecological receptors from other chemicals detected in environmental samples as well.

7.1 Baseline Human Health Risk Assessment

The potential for adverse human health effects is expressed as incremental lifetime cancer risks and non-cancer hazards that are based on assumptions regarding the potential for exposure, estimated COPC concentrations at the point of human contact, and the toxicity of each COPC.

For known or suspected carcinogens, the NCP established that acceptable exposure levels are generally concentration levels that represent an incremental upper-bound lifetime cancer risk in the range from 10^{-4} (*i.e.,* 1E-04 or 1 in 10,000) to 10^{-6} (*i.e.,* 1E-06 or 1 in 1,000,000) or less. Based on the RME scenarios evaluated in this BHHRA, total cancer risks greater than the risk range established by the NCP (*i.e.,* greater than 1E-04) were estimated for the following receptor populations:

- Adult and adolescent recreationists/sportsmen at all of the EUs on Bound Brook (EUs BB1, BB2, BB3, BB4, BB5, and BB6). The cancer risks are attributable to benzidine in Surface Sediment.
- Adult and adolescent anglers at every EU in the Study Area. The cancer risks are predominantly attributable to benzidine in Surface Sediment and total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet.
- Child anglers at every EU in the Study Area. The cancer risks are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet.
- Outdoor workers at EU BB3. The cancer risk is attributable to benzidine in All Sediment.
- Adult and child residents[35] at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The cancer risks are predominantly attributable to total PCB Aroclors in All Soil, but for adult residents at EU BB5, also to dieldrin in All Soil.

Cancer risks estimated for the above receptors at other EUs, for child anglers exposed to shellfish at all EUs in the Study Area, for commercial/industrial workers exposed to Surface Soil at all EUs, and for construction/utility workers exposed to All Soil at all EUs are less than or within the risk range established by the NCP. Cancer risks for adult and adolescent anglers are also less than 1E-04 for the shellfish ingestion pathway at all EUs in the Study Area; however, the total cancer risks for these receptors were greater than 1E-04 at most EUs due to contributions of cancer risk from exposure to COPCs in other environmental media.

For systemic toxicants, the NCP established that "acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effects during a lifetime or part of a lifetime,

[35] While residences are located within the OU4 Study Area boundary, OU4 addresses non-residential properties and parklands (or other town- and county-owned properties) only. The potential for adverse health effects from exposure to soil in residential yards near the former CDE facility is being addressed as part of OU1 investigations. Therefore, the residential scenario included herein is not an evaluation of actual current/future residential exposures but is a conservative assessment that is protective of most other receptor populations that may access floodplain areas within OU4.

incorporating an adequate margin of safety" (USEPA, 1990). As the non-cancer toxicity values are protective of the potential for adverse, non-cancer health effects, HQs greater than 1E+00 indicate the potential for non-cancer hazard. The total individual non-cancer HQs were summed for each exposure scenario to yield HIs that reflect the potential for adverse, non-cancer health effects from exposure to multiple chemicals. For the non-cancer assessment, exposure scenarios with an HI greater than 1 (*i.e.,* 1E+00) are of potential concern.

The potential for adverse, non-cancer health effects was indicated for:

- Adult recreationists/sportsmen at EU BB5. The hazard is attributable to total PCB Aroclors in Surface Sediment.
- Adolescent recreationists/sportsmen at four EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6). The hazards are predominantly attributable to total PCB Aroclors in Surface Sediment and Surface Soil.
- Adult and adolescent anglers at every EU in the Study Area, from exposure to fish fillet or shellfish, predominantly, and exposure to Surface Sediment and Surface Soil as described above for recreationists/sportsmen. The hazards from exposure to fish fillet are predominantly attributable to total PCB Aroclors and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet, but at EU BB2, also to heptachlor epoxide in bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors in Asiatic clams or crayfish.
- Child anglers at every EU in the Study Area. The hazards from exposure to fish fillet are attributable to heptachlor epoxide, total PCB Aroclors, and TCDD TEQ (PCBs) in predatory or bottom-feeding fish fillet. Hazards from exposure to shellfish are attributable to total PCB Aroclors and TCDD TEQ (PCBs) in Asiatic clams or total PCB Aroclors in crayfish.
- Outdoor workers at EU BB5. The hazard is attributable to total PCB Aroclors in All Sediment and All Soil.
- Adult residents at four of the EUs on Bound Brook (EUs BB3, BB4, BB5, and BB6) and child residents at every EU except SL, for which floodplain soil data were not available. The hazards for the adult resident are attributable to total PCB Aroclors in All Soil, while hazards for the child resident are predominantly attributable to total PCB Aroclors, but at EU BB3, also to antimony, iron, and thallium in All Soil, and at EU BB5, also to dieldrin in All Soil.

- Adult commercial/industrial workers at EUs BB5 and BB6. The hazards are attributable to total PCB Aroclors in Surface Soil.
- Adult construction/utility workers at every EU in the Study Area (except EU SL, for which floodplain soil data were not available), from inhalation exposure to manganese in All Soil.

The non-cancer hazards estimated for the above receptors at other EUs were less than 1.

This BHHRA confirms there is a potential for unacceptable cancer risk and non-cancer hazard from exposure to total PCB Aroclors in sediment, floodplain soil, fish, and shellfish that is relatively wide-spread throughout the Study Area. The non-cancer hazard from exposure to total PCB Aroclors in sediment is limited to EU BB5, but total PCB Aroclors in floodplain soil, fish fillet, or shellfish was the predominant contributor to a non-cancer HI greater than 1 for at least one receptor population at every EU. When evaluated as TCDD TEQ, PCBs in fish fillet or shellfish was the predominant contributor to an unacceptable cancer risk or non-cancer hazard for at least one receptor population at every EU.

Concentrations of other chemicals that were demonstrated to be predominant contributors to the unacceptable cancer risks and/or non-cancer hazards estimated in this BHHRA are not likely attributable to the former CDE facility. Heptachlor epoxide was a COC in bottom-feeding fish fillet from EUs BB2, BB3, and BB4 and in predatory fish fillet from EU BB5. Dieldrin was a COC in All Soil at EU BB5. However, pesticide concentrations detected in fish fillet and floodplain soil samples are not likely attributable to operations at the former CDE facility. Antimony, iron, and thallium were COCs in All Soil at EU BB3, and manganese was a COC in All Soil at every EU in the Study Area except SL, for which floodplain soil data were not available. Antimony, manganese, and thallium are naturally occurring metals found at trace levels in the environment. Iron and manganese are essential nutrients. Detected concentrations of antimony, iron, and manganese in All Soil are generally comparable to those detected in reference area samples and may therefore be reflective of background conditions, except for at EU BB3, where maximum concentrations are well outside the range of reference area soil concentrations. Thallium was not detected in reference area soil samples. However, typical thallium concentrations in soil are 0.3 – 0.7 mg/kg (ATSDR, 1992b) and thallium concentrations detected in All Soil at EU BB3 ranged from 0.56 – 4.0 mg/kg.

The exposure modeling conducted to evaluate exposures to lead only indicated a potential for elevated PbB (*i.e.*, greater than 10 µg/dL) for outdoor workers, construction/utility workers, and child residents exposed to All Soil at EU BB3. The modeled EPC (based on the arithmetic average concentration) was influenced by three relatively elevated observations that are statistical outliers in the data set. Therefore, the potential for elevated PbB may be localized to one or more locations within EU BB3.

The source of elevated metals concentrations in floodplain soil at EU BB3 is not known. Regardless, metals are not contaminants associated with the former CDE facility.

7.2 Ecological Risk Assessment

The following conclusions regarding the potential for adverse health effects from exposure to Site-related COPECs are made based on evaluation of the multiple lines of evidence for each assessment endpoint:

Protection of Benthic Invertebrates

Based on concordance of the following lines of evidence, there may be a potential for adverse health effects in benthic invertebrates associated with exposure to Site-related COCs. These include cis-1,2-DCE in porewater and Surface Sediment at EU BB5 and PCBs in porewater in EU BB5 and Surface Sediment in EUs BB2, BB3, BB4, BB5, and BB6.

- Comparison of sediment/porewater data to screening concentrations protective of benthic invertebrates: Refined HQs greater than 1 for total PCB Aroclors in Surface Sediment at EUs BB2, BB3, BB4, BB5, and BB6, HQ greater than 1 for vinyl chloride in Surface Sediment at EU BB5, and HQs greater than 1 for cis-1,2-DCE, vinyl chloride, total PCB congeners, and TCDD TEQ (PCBs) in porewater all indicate a potential for adverse health effects in benthic invertebrates. However, as discussed in Section 6.3, comparison of concentrations of cis-1,2-DCE and vinyl chloride in Surface Sediment to modified SQBs indicate that cis-1,2-DCE is more likely to be associated with potential adverse health effects than vinyl chloride.

- Comparison of benthic invertebrate tissue data to invertebrate critical body residues: HQnoaels and HQloaels greater than 1 for crayfish and Asiatic clam tissue concentrations of total PCB Aroclors at all EUs indicate a potential for adverse health effects in benthic invertebrates.

- Evaluation of sediment toxicity tests: Results of long-term tests with *H. Azteca* where a 38 percent reduction in growth in BB-SD01 (EU BB5) and a 42 percent reduction in growth in BB-SD03 (EU BB1) compared to the corresponding reference sediment; results of short-term tests with *C. dilutus* where a 68 percent reduction in growth in BB-SD01 (EU BB5) and a 21 percent reduction in growth in NMP-SD01 (EU BB2) compared to the corresponding reference sediment; and results of long-term tests with *C. dilutus* where a 139 percent reduction in 20-day percent survival in BB-SD01 (EU BB5), a 153 percent reduction in total percent emergence in BB-SD01 (EU BB5), and a 70 percent reduction in total percent emergence in BB-SD03 (EU BB1) compared to the corresponding reference sediment all indicate a toxic effect.

- Evaluation of bioaccumulation tests: Results of a 28-day bioaccumulation test with *L. variegates* in Bound Brook sediments had higher BSAFs than test specimens in reference sediment; test specimens in New Market Pond sediments had lower BSAFs than test specimens in reference sediments; and test specimens exposed to EU BB1 sediments exhibited the greatest bioaccumulation.

Protection of Aquatic Life (Fish)

Based on concordance of the following lines of evidence, there may be a potential for adverse health effects in aquatic life associated with exposure to Site-related COCs.

- Comparison of surface water/porewater data to screening concentrations protective of aquatic life: HQs greater than 1 for cis-1,2-DCE, vinyl chloride, total PCB congeners, and TCDD TEQ (PCBs) in surface water/porewater indicate a potential for adverse effects in aquatic life.

- Comparison of fish tissue data to fish critical body residues: HQnoaels and HQloaels greater than 1 for predatory and bottom-feeding whole body tissue concentrations of total PCB Aroclors at all EUs indicate a potential for adverse health effects in aquatic life. However, as discussed in Section 6.3, FCFs are generally equal to or greater than 1 for fish in all EUs, indicating fish within the OU4 Study Area appear to be healthy.

- Comparison of estimated concentrations in fish eggs to critical egg residues: While an HQnoael of 2 for TCDD TEQ (PCBs) at EU BB5 indicates the potential for adverse effects for bottom-feeding fish eggs, the HQloael is less than 1.

Protection of Semi-Aquatic Birds and Mammals

Based on concordance of the following lines of evidence, dietary exposure to PCBs in some semi-aquatic birds and mammals may be associated with adverse health effects.

- Comparison of modeled intakes to toxicity reference values: Insectivorous and piscivorous receptors with HQnoael greater than 1 for total PCB Aroclors and TCDD TEQ (PCBs) in all EUs, with the highest HQs for belted kingfisher at EU BB5 and HQnoael and HQloael greater than 1 for total PCB Aroclors and TCDD TEQ (PCBs) at one or more EUs, with the highest HQs for American mink at EU BB5.

- Comparison of estimated concentrations in bird eggs to critical egg residues: HQnoaels and HQloaels for total PCB Aroclors and TCDD TEQ (PCBs) in bird eggs based on both predatory and bottom-feeding fish concentrations in all EUs, with the highest HQs at EU BB5.

Protection of Terrestrial Plants and Invertebrates

Based on lack of concordance of the following lines of evidence, it is not likely that PCBs in Surface Soil are associated with wide-spread adverse health effects in terrestrial plants and invertebrates throughout the Bound Brook floodplains. As discussed in Section 6.3, plant uptake of PCBs is considered to be negligible due to the large molecular weight and strong sorption of PCBs to organic matter (Bacci and Gaggi, 1985) and while accumulation in the tissues of soil invertebrates provides direct evidence of bioavailability, bioaccumulation alone is not an indication of adverse health effects.

- Comparison of floodplain soil data to screening concentrations protective of soil invertebrates: Total PCB Aroclors were selected as a refined COPEC in Surface Soil at EU BB6.

- Evaluation of soil bioaccumulation tests: Results of 28-day bioaccumulation test with *E. fetida* in Bound Brook soils had higher total PCB tissue residues than test specimens in the corresponding reference soil.

Protection of Terrestrial Birds and Mammals

Although uncertainty is associated with literature-based ESVs, based on concordance of the following lines of evidence, dietary exposure to PCBs based on site-specific bioaccumulation in soil invertebrates may be associated with adverse health effects in terrestrial insectivorous birds and mammals.

- Comparison of floodplain soil data to screening concentrations protective of wildlife: HQs greater than 1 for total PCB Aroclors in Surface Soil at all EUs.

- Comparison of modeled intakes to toxicity reference values: HQnoael and HQloael greater than 1 for terrestrial insectivorous birds and mammals at EUs BB3, BB4, BB5, BB6, and SL.

This ERA also confirms that there is a potential for adverse health effects in ecological receptors from exposure to numerous other non-Site-related COPEC within the OU4 Study Area. The potential for adverse health effects in ecological receptors associated with exposure to COPECs that are not Site-related is discussed below by chemical class.

- Volatile Organic Compounds - Acetone (EUs BB1, BB2, BB3, BB4, BB5, BB6, and SL) and toluene (EU BB5) were detected in Surface Sediment at concentrations greater than the ESVs resulting in HQs greater than 1 and indicating a potential for adverse health effects in benthic invertebrates. Acetone and toluene, however, are common laboratory contaminants.

- Semi-Volatile Organic Compounds - Seven SVOCs retained as refined COPECs [*i.e.*, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, diethylphthalate, 2-methylnaphthalene, 3-/4-methylphenol, and phenol] were detected in Surface Sediment and Surface Soil in one or more EUs at concentrations greater than the ESVs (HQs greater than 1) indicating a potential for adverse health effects in benthic invertebrates (Surface Sediment) or birds and mammals (Surface Soil). Accumulation in tissue does not necessarily indicate toxicity, however, both bis(2-ethylhexyl) phthalate and di-n-butyl phthalate were detected in crayfish tissue collected during the USEPA's 1997 Ecological Evaluation (USEPA, 1999a). Phthalates, however, are also common laboratory contaminants.

- Polycyclic Aromatic Hydrocarbons - Fifteen individual PAHs were retained as refined COPECs in Surface Sediment at multiple EUs throughout the OU4 Study Area. Based on comparison of detected concentrations to ESVs resulting in HQs greater than 1, there is a potential for adverse health effects in benthic invertebrates. Benzo(a,h)anthracene and benzo(a)pyrene were detected in surface water at concentrations exceeding the ESVs, indicating there may be a potential for adverse health effects in aquatic life.

  Total HMW PAHs were retained as refined COPECs based on comparison of detected concentrations in Surface Soil to ESVs protective of both terrestrial plants and invertebrates (EU BB5) and birds and mammals (all EUs, except SL for which floodplain soil data were not available) indicating a potential for adverse health effects. Based on estimated PAH concentrations in plants growing in Surface Sediment and subsequent dietary exposure to higher trophic level organisms (*i.e.*, wood duck and muskrat, there is a potential for adverse health effects in semi-aquatic mammals from exposure to HMW PAHs bioaccumulated in plants. Based on estimated PAH concentrations in plants growing in Surface Soil and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel), adverse health effects in terrestrial herbivorous receptors are not likely associated with exposure to PAHs bioaccumulated in plants.

- Pesticides - Twelve pesticides (*i.e.*, alpha-BHC, beta-BHC, gamma-BHC, total chlordane, dieldrin, total DDx, alpha- and beta-endosulfan, endrin, heptachlor, heptachlor epoxide, and methocxychlor) were retained as refined COPECs in Surface Sediment in one or more EUs (including EUs BB1 through BB6 and SL) based on comparison of detected concentrations to ESVs protective of benthic invertebrates indicating a potential for adverse health effects (HQs greater than 1). Of these, only total DDx and heptachlor epoxide were detected in biota tissue samples (whole body predatory fish only). Based on tissue residue evaluation for whole body predatory fish, the bird egg residue evaluation, and food web modeling for semi-aquatic piscivorous birds (*i.e.*, great blue heron and belted kingfisher) and mammals (*i.e.*, American mink), and omnivorous mammals (*i.e.*, raccoon), it is unlikely that exposure to total DDx or heptachlor epoxide is associated with adverse health effects in aquatic life (fish) or semi-aquatic birds or mammals within the OU4 Study Area (all HQs less than 1).

Seventeen pesticides were retained as refined COPECs in Surface Sediment for evaluation of herbivorous semi-aquatic wildlife. Based on estimated pesticide concentrations in aquatic plants and subsequent dietary exposure to higher trophic level organisms (*i.e.*, wood duck and muskrat), terrestrial herbivorous mammals may be at increased risk for adverse health effects from exposure to dieldrin at EUs BB5 and BB6 (HQnoael greater than 1), beta-endosulfan at EU BB5 (HQnoael greater than 1), and endrin at EUs BB4 and BB5 (HQnoael greater than 1) within the OU4 Study Area.

Of the pesticides detected in Surface Soil, only aldrin was detected at concentrations greater than the ESVs protective of plants and invertebrates indicating a potential for adverse health effects. Seven pesticides (*i.e.,* dieldrin, total DDx, beta-endosulfan, endrin aldehyde, heptachlor, heptachlor epoxide, and methoxychlor) were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals. Of these, only dieldrin and heptachlor epoxide were detected in mouse tissue samples. Based on food web modeling for terrestrial carnivorous birds and mammals (*i.e.*, red-tailed hawk and red fox), it is unlikely that exposure to dieldrin or heptachlor epoxide is associated with adverse health effects in terrestrial birds or mammals within the OU4 Study Area (all HQs less than 1). In addition, based on estimated pesticide concentrations in plants and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to pesticides bioaccumulated in plants (HQs less than 1 except for dieldrin in EU BB5 where the HQnoael was 19) within the OU4 Study Area.

- Metals and Cyanide - Aluminum, manganese, and cyanide were retained as refined COPECs in surface water based on comparison of detected concentrations to ESVs protective of aquatic life indicating a potential for adverse health effects in aquatic life (HQs greater than 1). Eight metals (*i.e.*, cadmium, copper, lead, manganese, mercury, nickel silver, and zinc) and cyanide were retained as refined COPECs in Surface Sediment in one or more EUs based on comparison of detected concentrations to ESVs protective of benthic invertebrates, indicating a potential for adverse health effects.

The bioaccumulative metals arsenic, cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were detected in aquatic biota tissue samples (predatory fish and/or crayfish). Based on tissue residue evaluation for crayfish, arsenic, cadmium, chromium, lead, mercury, nickel, selenium, silver, and zinc were associated with HQs greater than 1 at one or more EUs. The tissue residue evaluation indicates that metals concentrations bioaccumulated in tissue may be capable of causing adverse health effects in benthic invertebrates within the OU4 Study Area.

Based on tissue residue evaluation for whole body predatory fish, arsenic, cadmium, copper, lead, mercury, selenium, silver, and zinc were associated with HQs greater than 1 at one or more EUs. The tissue residue evaluation indicates that metals concentrations bioaccumulated in tissue may be capable of causing adverse health effects in fish within the OU4 Study Area.

Twelve metals (*i.e.*, aluminum, barium, chromium, copper, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of terrestrial plants and invertebrates. Eleven metals (*i.e.*, antimony, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium, vanadium, and zinc) and cyanide were retained as refined COPECs in Surface Soil in one or more EUs based on comparison of detected concentrations to ESVs protective of birds and mammals.

Based on estimated bioaccumulative metals concentrations in plants and subsequent dietary exposure to higher trophic level organisms (*i.e.*, mourning dove and eastern gray squirrel), terrestrial herbivorous receptors are generally not likely at risk for adverse health effects associated with exposure to metals in soil (HQs less than 1 with the exception of zinc at EU BB3 where the HQnoael was 2) within the OU4 Study Area.

Whole sediment toxicity tests and sediment and floodplain soil bioaccumulation tests were conducted during the OU4 RI. Both short-term and long-term whole sediment toxicity tests (measuring both lethal and sublethal endpoints) were conducted with the amphipod *H. azteca* and the chironomid *C. dilutus* on samples collected in Bound Brook (EUs BB 5, BB3, and BB1) and New Market Pond (EU BB2). Tests included both control sediments and corresponding reference sediments.

Statistically significant differences between test and reference sediments were observed with both test species, for a variety of endoints, in a number of EUs opposite and downstream of the former CDE facility. EU BB5 had four toxic responses, EU BB1 had two toxic responses, and EU BB2 had one toxic response. In addition, where there was a discernible difference between EUs based on the toxicity response metric, EU BB5 had the greater toxic response. Therefore, EU BB5 seems to produce the greatest toxic effect in test specimens, and would be expected to pose the greatest risk to benthic populations.

The USEPA conducted a short-term sediment toxicity tests with the amphipod *H. azteca* during the 1997 Ecological Evaluation (USEPA, 1999a). There were a number of differences in the methods used in the two *H. azteca* tests conducted during the 1997 Ecological Evaluation and the OU4 RI.

Percent survival was the only endpoint common to the 1997 and OU4 RI tests. In both tests, survival in EU BB3 test sediments was statistically significantly different than that observed in the corresponding reference sediments. Percent survival in the 1997 test sediments (76.7 percent) indicates a toxic effect (USEPA, 1994b), while percent survival in the OU4 RI test sediment (90 percent) does not.

Sediment bioaccumulation tests for PCBs with the freshwater oligochaete *L. variegates* and floodplain soil bioaccumulation tests for PCBs with the terrestrial oligochaete *E. fetida* indicate that, as expected, PCBs bioaccumulate in invertebrate tissue.

L. variegates specimens in test sediments had higher post-exposure tissue residues of total PCBs than specimens in the corresponding reference sediments, with the highest total PCB concentrations in specimens exposed to sediments from EU BB5 and EU BB1. *L. variegates* specimens in Bound Brook test sediments had higher BSAFs than specimens in the corresponding reference sediments. *L. variegates* specimens exposed to EU BB1 sediments exhibited the greatest bioaccumulation.

E. fetida specimens in test soils had higher post-exposure tissue residues of total PCBs than specimens in reference soil, with the highest total PCB concentrations in specimens exposed to soil from EU BB4. *E. fetida* specimens exposed to EU BB4 soil exhibited the greatest bioaccumulation.

While accumulation of PCBs in the tissues of invertebrates provides direct evidence of bioavailability, bioaccumulation alone is not an indication of adverse health effects. However, as invertebrates are an important food source to higher trophic level organisms, dietary exposure to PCBs for higher trophic level organisms is a prominent exposure pathway.

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TABLES

Table ES-1: Summary of COPCs Identified in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Concern	Surface Water	Sediment																Floodplain Soil														Predatory Fish		Bottom-Feeding Fish		Invertebrates	
		Surface Sediment								All Sediment								Surface Soil							All Soil							Fish Fillet	Spring Lake	Fish Fillet	Spring Lake	Asiatic Clams	Crayfish
		GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6						
cis-1,2-Dichloroethene	X						X								X								X							X							
Vinyl chloride							X								X																						
Trichloroethene	X																																				
Acenaphthylene			X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzidine			X	X	X	X	X	X				X	X	X	X																						
Benzo(a)anthracene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(a)pyrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(b)fluoranthene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(g,h,i)perylene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(k)fluoranthene			X	X	X		X		X		X	X	X		X		X		X		X	X	X			X		X	X	X	X						
bis(2-Ethylhexyl) phthalate				X	X		X					X	X		X						X		X					X		X							
Carbazole			X	X	X	X	X		X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Chrysene																																					
Dibenzo(a,h)anthracene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
1,3-Dichlorobenzene							X								X																						
Dimethyl phthalate																			X				X			X				X	X						
di-n-Octyl phthalate				X	X	X	X					X	X	X	X				X		X	X	X	X		X		X	X	X	X						
Indeno(1,2,3-cd)pyrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
p-Isopropyltouene			X			X			X		X			X			X																				
Phenanthrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Aldrin																						X							X								
alpha-BHC													X																								
delta-BHC			X																			X							X								
gamma-BHC															X																						
alpha-Chlordane																																		X	X		
gamma-Chlordane																																		X	X		
Dieldrin					X		X					X	X	X	X							X	X						X	X			X		X		
4,4'-DDD																																X		X	X		
4,4'-DDE															X								X							X		X	X	X	X		
4,4'-DDT							X								X							X							X								
Endosulfan sulfate						X							X							X		X	X				X		X	X							
Endrin															X																						
Endrin aldehyde			X		X	X	X				X		X	X	X	X			X		X	X	X			X		X		X		X					
Endrin ketone			X	X	X	X	X				X			X	X						X	X		X				X		X	X						
Heptachlor epoxide							X						X	X	X								X							X		X	X	X	X		
Total PCB Aroclors / Congeners	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TCDD TEQ (PCBs)																																X	X	X	X	X	
Aluminum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Antimony							X								X						X	X	X					X	X	X							
Arsenic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		X
Cadmium				X	X	X	X	X			X	X	X	X	X	X			X		X	X	X	X				X	X	X	X						
Chromium																																					
Cobalt		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		
Copper			X								X										X	X	X					X	X	X				X			
Cyanide	X																							X							X						
Iron		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Lead								X								X					X	X	X					X	X	X	X	X	X		X		X
Manganese	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Mercury																		X			X				X			X				X	X	X	X		
Nickel											X										X							X									
Selenium																																X		X			
Silver																						X							X								
Thallium								X								X					X							X									
Vanadium		X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X		X	X	X		X	X		X	X	X							
Zinc																					X							X	X								

Table ES-2: Summary of Estimated Cancer Risks and Non-cancer Hazards - Reasonable Maximum Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Recreationist/Sportsman - Adult																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	**1E-03**	4E-01	**2E-03**	2E-01	**4E-03**	4E-01	**2E-03**	5E-01	**1E-03**	**2E+00**	**8E-04**	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Total per Receptor and EU	1E-05	3E-01	**1E-03**	7E-01	**2E-03**	6E-01	**4E-03**	9E-01	**2E-03**	1E+00	**1E-03**	**3E+00**	**8E-04**	1E+00	3E-05	3E-01
Recreationist/Sportsman - Adolescent																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Total per Receptor and EU	5E-06	5E-01	**3E-04**	1E+00	**3E-04**	8E-01	**9E-04**	**2E+00**	**4E-04**	**2E+00**	**3E-04**	**5E+00**	**2E-04**	**3E+00**	8E-06	4E-01
Angler - Adult (Predatory Fish Fillet)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	**1E-03**	4E-01	**2E-03**	2E-01	**4E-03**	4E-01	**2E-03**	5E-01	**1E-03**	**2E+00**	**8E-04**	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Predatory fish	**4E-04**	**2E+01**	**4E-04**	**2E+01**	**6E-04**	**3E+01**	**1E-03**	**5E+01**	**1E-03**	**5E+01**	**4E-03**	**1E+02**	1E-04	**5E+00**	**3E-04**	**1E+01**
Total per Receptor and EU	**4E-04**	**2E+01**	**2E-03**	**2E+01**	**2E-03**	**3E+01**	**5E-03**	**5E+01**	**3E-03**	**5E+01**	**5E-03**	**1E+02**	**9E-04**	**6E+00**	**3E-04**	**1E+01**
Angler - Adult (Bottom-Feeding Fish Fillet)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	**1E-03**	4E-01	**2E-03**	2E-01	**4E-03**	4E-01	**2E-03**	5E-01	**1E-03**	**2E+00**	**8E-04**	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Bottom-feeding fish	**5E-03**	**3E+02**	**5E-03**	**3E+02**	**8E-03**	**3E+02**	**3E-03**	**1E+02**	**3E-03**	**1E+02**	**2E-02**	**6E+02**	**2E-03**	**1E+02**	**3E-03**	**1E+02**
Total per Receptor and EU	**5E-03**	**3E+02**	**7E-03**	**3E+02**	**9E-03**	**3E+02**	**7E-03**	**1E+02**	**4E-03**	**1E+02**	**2E-02**	**6E+02**	**3E-03**	**1E+02**	**3E-03**	**1E+02**
Angler - Adult (Asiatic Clams)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	**1E-03**	4E-01	**2E-03**	2E-01	**4E-03**	4E-01	**2E-03**	5E-01	**1E-03**	**2E+00**	**8E-04**	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Asiatic clams	1E-04	**4E+00**	1E-04	**4E+00**	1E-04	**4E+00**	1E-04	**4E+00**	1E-04	**4E+00**	1E-04	**4E+00**	8E-06	3E-01	1E-04	**4E+00**
Total per Receptor and EU	1E-04	**4E+00**	**1E-03**	**5E+00**	**2E-03**	**4E+00**	**4E-03**	**5E+00**	**2E-03**	**5E+00**	**1E-03**	**7E+00**	**8E-04**	**2E+00**	1E-04	**4E+00**
Angler - Adult (Crayfish)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	**1E-03**	4E-01	**2E-03**	2E-01	**4E-03**	4E-01	**2E-03**	5E-01	**1E-03**	**2E+00**	**8E-04**	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Crayfish	5E-05	**2E+00**	5E-05	**2E+00**	5E-05	**2E+00**	5E-05	**2E+00**	5E-05	**2E+00**	5E-05	**2E+00**	5E-05	**3E+00**	5E-05	**2E+00**
Total per Receptor and EU	6E-05	**2E+00**	**1E-03**	**3E+00**	**2E-03**	**3E+00**	**4E-03**	**3E+00**	**2E-03**	**3E+00**	**1E-03**	**5E+00**	**9E-04**	**4E+00**	9E-05	**2E+00**
Angler - Adolescent (Predatory Fish Fillet)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Predatory fish	1E-04	**2E+01**	1E-04	**2E+01**	**2E-04**	**2E+01**	**4E-04**	**5E+01**	**4E-04**	**5E+01**	**1E-03**	**1E+02**	4E-05	**5E+00**	1E-04	**1E+01**
Total per Receptor and EU	1E-04	**2E+01**	**4E-04**	**2E+01**	**6E-04**	**2E+01**	**1E-03**	**5E+01**	**8E-04**	**5E+01**	**2E-03**	**1E+02**	**2E-04**	**8E+00**	1E-04	**1E+01**
Angler - Adolescent (Bottom-Feeding Fish Fillet)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Bottom-feeding fish	**2E-03**	**3E+02**	**2E-03**	**3E+02**	**3E-03**	**3E+02**	**1E-03**	**1E+02**	**1E-03**	**1E+02**	**7E-03**	**6E+02**	**7E-04**	**1E+02**	**1E-03**	**1E+02**
Total per Receptor and EU	**2E-03**	**3E+02**	**2E-03**	**3E+02**	**3E-03**	**3E+02**	**2E-03**	**1E+02**	**1E-03**	**1E+02**	**7E-03**	**6E+02**	**9E-04**	**1E+02**	**1E-03**	**1E+02**
Angler - Adolescent (Asiatic Clams)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Asiatic clams	4E-05	**4E+00**	4E-05	**4E+00**	4E-05	**4E+00**	4E-05	**4E+00**	4E-05	**4E+00**	4E-05	**4E+00**	3E-06	2E-01	4E-05	**4E+00**
Total per Receptor and EU	4E-05	**4E+00**	**3E-04**	**5E+00**	**4E-04**	**4E+00**	**9E-04**	**5E+00**	**4E-04**	**5E+00**	**3E-04**	**9E+00**	**2E-04**	**4E+00**	4E-05	**4E+00**

Table ES-2: Summary of Estimated Cancer Risks and Non-cancer Hazards - Reasonable Maximum Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Angler - Adolescent (Crayfish)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Crayfish	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**3E+00**	2E-05	**2E+00**
Total per Receptor and EU	2E-05	**2E+00**	**3E-04**	**3E+00**	**4E-04**	**3E+00**	**9E-04**	**4E+00**	**4E-04**	**4E+00**	**3E-04**	**7E+00**	**2E-04**	**6E+00**	3E-05	**2E+00**
Angler - Child (Predatory Fish Fillet)																
Predatory fish	1E-04	**3E+01**	1E-04	**3E+01**	**2E-04**	**4E+01**	**4E-04**	**8E+01**	**4E-04**	**8E+01**	**1E-03**	**2E+02**	4E-05	**8E+00**	9E-05	**2E+01**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Bottom-Feeding Fish Fillet)																
Bottom-feeding fish	**2E-03**	**4E+02**	**2E-03**	**4E+02**	**2E-03**	**4E+02**	**8E-04**	**2E+02**	**8E-04**	**2E+02**	**6E-03**	**9E+02**	**6E-04**	**2E+02**	**8E-04**	**2E+02**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Asiatic clams)																
Asiatic clams	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	2E-06	4E-01	3E-05	**6E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Crayfish)																
Crayfish	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**4E+00**	2E-05	**3E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Outdoor Worker - Adult																
Surface water	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01
Sediment - all sediment	2E-07	4E-02	6E-05	2E-01	7E-05	2E-01	**2E-04**	3E-01	8E-05	2E-01	5E-05	7E-01	4E-05	8E-02	1E-06	5E-02
Floodplain soil - all soil	2E-07	1E-01	4E-07	1E-01	3E-07	1E-01	1E-06	7E-01	1E-06	5E-01	3E-06	9E-01	2E-06	1E+00	not applicable	
Total per Receptor and EU	6E-07	3E-01	6E-05	4E-01	7E-05	4E-01	**2E-04**	1E+00	8E-05	9E-01	5E-05	**2E+00**	4E-05	1E+00	1E-06	2E-01
Resident - Adult																
Floodplain soil - all soil	6E-05	3E-01	8E-05	3E-01	5E-05	3E-01	**3E-04**	**2E+00**	**2E-04**	**2E+00**	**6E-04**	**4E+00**	**4E-04**	**7E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Resident - Child																
Floodplain soil - all soil	5E-05	**2E+00**	7E-05	**2E+00**	4E-05	**2E+00**	**2E-04**	**2E+01**	**2E-04**	**2E+01**	**4E-04**	**4E+01**	**3E-04**	**6E+01**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Commercial/Industrial Worker - Adult																
Floodplain soil - surface soil	1E-05	2E-01	1E-05	2E-01	1E-05	2E-01	3E-05	1E+00	4E-05	1E+00	1E-04	**4E+00**	8E-05	**5E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Construction/Utility Worker - Adult																
Floodplain soil - all soil	4E-07	**7E+00**	5E-07	**6E+00**	4E-07	**5E+00**	1E-06	**8E+00**	1E-06	**5E+00**	4E-06	**7E+00**	2E-06	**6E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			

Notes

Cancer risks greater than 1E-04 and non-cancer hazards greater than 1E+00 are bolded and shaded.

Exposure Unit (EU) Abbreviations:
GB = Green Brook (RM -1.58 to 0)
BB1 = Bound Brook (RM 0 to 3.43)
BB2 = Bound Brook (RM 3.43 to 4.09)
BB3 = Bound Brook (RM 4.09 to 5.22)
BB4 = Bound Brook (RM 5.22 to RM 6.18)
BB5 = Bound Brook (RM 6.18 to 6.82)
BB6 = Bound Brook (RM 6.82 to RM 8.31)
SL = Spring Lake

Table ES-3: Summary of Estimated Cancer Risks and Non-cancer Hazards - Central Tendency Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Recreationist/Sportsman - Adult																
Surface water			7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01		
Sediment - surface sediment			**2E-04**	2E-01	**2E-04**	1E-01	**6E-04**	2E-01	**2E-04**	2E-01	**2E-04**	8E-01	1E-04	3E-02		
Floodplain soil - surface soil			3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01		
Total per Receptor and EU			**2E-04**	4E-01	**2E-04**	3E-01	**6E-04**	4E-01	**2E-04**	5E-01	**2E-04**	1E+00	1E-04	5E-01		
Recreationist/Sportsman - Adolescent																
Surface water			8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01		
Sediment - surface sediment			1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02		
Floodplain soil - surface soil			7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00		
Total per Receptor and EU			1E-04	5E-01	**2E-04**	4E-01	**4E-04**	7E-01	**2E-04**	7E-01	1E-04	**2E+00**	9E-05	1E+00		
Angler - Adult (Predatory Fish Fillet)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	**2E-04**	2E-01	**2E-04**	1E-01	**6E-04**	2E-01	**2E-04**	2E-01	**2E-04**	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Predatory fish	8E-05	**2E+01**	8E-05	**2E+01**	1E-04	**2E+01**	**3E-04**	**4E+01**	**3E-04**	**4E+01**	**8E-04**	**9E+01**	3E-05	**4E+00**	7E-05	**1E+01**
Total per Receptor and EU	8E-05	**2E+01**	**3E-04**	**2E+01**	**4E-04**	**2E+01**	**9E-04**	**4E+01**	**5E-04**	**4E+01**	**1E-03**	**9E+01**	1E-04	**4E+00**	7E-05	**1E+01**
Angler - Adult (Bottom-Feeding Fish Fillet)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	**2E-04**	2E-01	**2E-04**	1E-01	**6E-04**	2E-01	**2E-04**	2E-01	**2E-04**	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Bottom-feeding fish	**1E-03**	**2E+02**	**1E-03**	**2E+02**	**2E-03**	**2E+02**	**6E-04**	**8E+01**	**6E-04**	**8E+01**	**4E-03**	**5E+02**	**4E-04**	**8E+01**	**6E-04**	**1E+02**
Total per Receptor and EU	**1E-03**	**2E+02**	**1E-03**	**2E+02**	**2E-03**	**2E+02**	**1E-03**	**8E+01**	**9E-04**	**8E+01**	**5E-03**	**5E+02**	**6E-04**	**8E+01**	**6E-04**	**1E+02**
Angler - Adult (Asiatic Clams)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	**2E-04**	2E-01	**2E-04**	1E-01	**6E-04**	2E-01	**2E-04**	2E-01	**2E-04**	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Asiatic clams	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-06	2E-01	2E-05	**3E+00**
Total per Receptor and EU	2E-05	**3E+00**	**2E-04**	**3E+00**	**3E-04**	**3E+00**	**6E-04**	**4E+00**	**3E-04**	**4E+00**	**2E-04**	**4E+00**	1E-04	7E-01	3E-05	**3E+00**
Angler - Adult (Crayfish)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	**2E-04**	2E-01	**2E-04**	1E-01	**6E-04**	2E-01	**2E-04**	2E-01	**2E-04**	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Crayfish	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**
Total per Receptor and EU	1E-05	**2E+00**	**2E-04**	**2E+00**	**2E-04**	**2E+00**	**6E-04**	**2E+00**	**3E-04**	**2E+00**	**2E-04**	**3E+00**	1E-04	**3E+00**	2E-05	**2E+00**
Angler - Adolescent (Predatory Fish Fillet)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Predatory fish	8E-05	**2E+01**	8E-05	**2E+01**	1E-04	**2E+01**	**3E-04**	**4E+01**	**3E-04**	**4E+01**	**8E-04**	**9E+01**	3E-05	**4E+00**	6E-05	**1E+01**
Total per Receptor and EU	8E-05	**2E+01**	**2E-04**	**2E+01**	**3E-04**	**2E+01**	**7E-04**	**4E+01**	**4E-04**	**4E+01**	**9E-04**	**9E+01**	1E-04	**5E+00**	7E-05	**1E+01**
Angler - Adolescent (Bottom-Feeding Fish Fillet)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Bottom-feeding fish	**1E-03**	**2E+02**	**1E-03**	**2E+02**	**2E-03**	**3E+02**	**6E-04**	**8E+01**	**6E-04**	**8E+01**	**4E-03**	**4E+02**	**4E-04**	**8E+01**	**6E-04**	**9E+01**
Total per Receptor and EU	**1E-03**	**2E+02**	**1E-03**	**2E+02**	**2E-03**	**3E+02**	**1E-03**	**8E+01**	**8E-04**	**8E+01**	**4E-03**	**4E+02**	**5E-04**	**8E+01**	**6E-04**	**9E+01**
Angler - Adolescent (Asiatic Clams)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Asiatic clams	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-06	2E-01	2E-05	**3E+00**
Total per Receptor and EU	2E-05	**3E+00**	1E-04	**3E+00**	**2E-04**	**3E+00**	**4E-04**	**4E+00**	**2E-04**	**4E+00**	1E-04	**5E+00**	9E-05	1E+00	2E-05	**3E+00**

Table ES-3: Summary of Estimated Cancer Risks and Non-cancer Hazards - Central Tendency Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Angler - Adolescent (Crayfish)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Crayfish	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**
Total per Receptor and EU	1E-05	**2E+00**	1E-04	**2E+00**	**2E-04**	**2E+00**	**4E-04**	**2E+00**	**2E-04**	**2E+00**	1E-04	**3E+00**	1E-04	**3E+00**	2E-05	**2E+00**
Angler - Child (Predatory Fish Fillet)																
Predatory fish	8E-05	**3E+01**	8E-05	**3E+01**	1E-04	**3E+01**	**3E-04**	**6E+01**	**3E-04**	**6E+01**	**8E-04**	**1E+02**	3E-05	**6E+00**	7E-05	**2E+01**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Bottom-Feeding Fish Fillet)																
Bottom-feeding fish	**1E-03**	**4E+02**	**1E-03**	**4E+02**	**2E-03**	**4E+02**	**6E-04**	**1E+02**	**6E-04**	**1E+02**	**5E-03**	**7E+02**	**5E-04**	**1E+02**	**7E-04**	**2E+02**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Asiatic clams)																
Asiatic clams	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**			2E-05	**5E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above				same as above	
Angler - Child (Crayfish)																
Crayfish	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**4E+00**	1E-05	**3E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Outdoor Worker - Adult																
Surface water							6E-08	4E-02			6E-08	4E-02				
Sediment - all sediment							6E-05	1E-01			2E-05	2E-01				
Floodplain soil - all soil							3E-07	2E-01			1E-06	3E-01				
Total per Receptor and EU							6E-05	4E-01			2E-05	5E-01				
Resident - Adult																
Floodplain soil - all soil							2E-05	**2E+00**	2E-05	**2E+00**	5E-05	**3E+00**	3E-05	**5E+00**	not applicable	
Total per Receptor and EU							same as above		same as above		same as above		same as above			
Resident - Child																
Floodplain soil - all soil	4E-05	**2E+00**	6E-05	**2E+00**	3E-05	**2E+00**	**2E-04**	**2E+01**	1E-04	**2E+01**	**4E-04**	**3E+01**	**2E-04**	**4E+01**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Commercial/Industrial Worker - Adult																
Floodplain soil - surface soil											3E-05	**2E+00**	1E-05	**3E+00**	not applicable	
Total per Receptor and EU											same as above		same as above			
Construction/Utility Worker - Adult																
Floodplain soil - all soil	1E-07	**5E+00**	1E-07	**4E+00**	1E-07	**4E+00**	4E-07	**6E+00**	4E-07	**4E+00**	1E-06	**5E+00**	6E-07	**4E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			

Notes

Cancer risks greater than 1E-04 and non-cancer hazards greater than 1E+00 are bolded and shaded.

Exposure Unit (EU) Abbreviations:
GB = Green Brook (RM -1.58 to 0)
BB1 = Bound Brook (RM 0 to 3.43)
BB2 = Bound Brook (RM 3.43 to 4.09)
BB3 = Bound Brook (RM 4.09 to 5.22)
BB4 = Bound Brook (RM 5.22 to RM 6.18)
BB5 = Bound Brook (RM 6.18 to 6.82)
BB6 = Bound Brook (RM 6.82 to RM 8.31)
SL = Spring Lake

Table ES-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Volatile Organic Chemicals																								
Acetone				X	X	X	X	X	X	X			O	O	O	O								
Benzene																								
Carbon disulfide															O									
Carbon tetrachloride															O									
Chloroform															O									
Chloroethane						O																		
Chloromethane						O									O									
Cyclohexane															O	O						O	O	
cis-1,2-Dichloroethene		X				O	O	O		O					O	O						O	O	
trans-1,2-Dichloroethene																O								
1,1-Dichloroethane								X	X						O									
1,1-Dichloroethene															O									
cis-1,3-Dichloropropene															O									
trans-1,3-Dichloropropene															O									
Ethylbenzene															O	O								
2-Hexanone															O									
Methyl acetate															O							O		
Methyl ethyl ketone					X				X					O	O	O	O							
Methyl isobutyl ketone															O	O								
Methyl tert-butyl ether				O						O														
Methylcyclohexane															O							O		
Methylene chloride														O	O	O								
Toluene								X																
1,2,3-Trichlorobenzene								O																
1,1,1-Trichloroethane														O	O									
Trichlorofluoromethane														O	O	O								
1,1,2-Trichloro-1,2,2-trifluoroethane								O	O															
Vinyl chloride		X						X																
m,p-Xylenes																						O		

Table ES-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Semi-Volatile Organic Chemicals																								
Acenaphthene				X	X	X	X	X	X	X														
Acenaphthylene				X	X	X	X	X	X															
Acetophenone				O		O	O	O		O		O		O		O	O							
Anthracene			X	X	X	X	X	X	X	X														
Benzaldehyde				O	O			O				O				O	O		O				O	O
Benzidine				O	O	O	O	O	O															
Benzo(a)anthracene			X	X	X	X	X	X	X	X														
Benzo(a)pyrene			X	X	X	X	X	X	X	X														
Benzo(b)fluoranthene																								
Benzo(g,h,i)perylene			X	X	X	X	X	X	X	X														
Benzoic acid						O	O	O																
Benzo(k)fluoranthene			X	X	X	X	X	X	X	X														
bis(2-Chloroethyl) ether														O										
bis(2-Chloroisopropyl) ether														O										
bis(2-Ethylhexyl) phthalate			X	X	X	X	X	X	X	X				O	O	O	O				X	X	X	X
Biphenyl																			O	O	O	O	O	O
n-Butylbenzene								O																
Butyl benzyl phthalate							X	X				O		O	O	O	O				X	X	X	
Caprolactam												O							O					
Carbazole				O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Chrysene			X	X	X	X	X	X	X	X														
Dibenzo(a,h)anthracene			X	X	X	X	X	X	X	X														
Dibenzofuran											O	O	O	O	O	O	O	O	O	O	O	O	O	O
3,3'-Dichlorobenzidine															O									
2,4-Dimethylphenol																								
Diethyl phthalate																							X	
Dimethyl phthalate												O		O		O								
di-n-Butyl phthalate						X	X	X													X		X	
di-n-Octyl phthalate												O		O	O	O	O							
2,6-Dinitrotoluene								X																
Fluoranthene			X	X	X	X	X	X	X	X														
Fluorene				X	X	X	X	X																
Hexachlorobenzene												O			O	O								
Indeno(1,2,3-c,d)pyrene			X	X	X	X	X	X	X	X														
p-Isopropyltouene				O			O			O														

Table ES-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
2-Methylnaphthalene				X	X	X	X	X				O			O	O	O							
2-Methylphenol																								
3- & 4-Methylphenol				X	X	X		X																
4-Methylphenol												O		O	O	O								
Naphthalene				X	X																			
4-Nitroaniline															O									
N-Nitrosodiphenylamine																								
Phenanthrene			X	X	X	X	X	X	X	X														
Phenol							X	X																
Pyrene			X	X	X	X	X	X	X	X														
1,2,4,5-Tetrachlorobenzene																								
HMW PAHs												X		X	X	X		X	X	X	X	X	X	X
Pesticides																								
Aldrin															X				O		O	O	O	O
alpha-BHC						X	X	X				O	O	O	O	O								
beta-BHC				X	X	X	X		X												O	O	O	
delta-BHC															O									
gamma-BHC						X	X	X							X				O			O	O	
Chlordane, Total				X	X	X	X	X	X	X					X	X			O		O	O	O	O
Dieldrin				X		X	X	X	X			O		O	O	O	O		X		X	X	X	X
Total DDx				X	X	X	X	X	X	X		O		O	O	O	O		X		X	X	X	X
alpha-Endosulfan						X	X					O			O	O								
beta-Endosulfan						X	X	X						O	O	O	O					X		
Endosulfan sulfate													O		O	O								
Endrin				X	X	X	X	X					O	O	O									
Endrin aldehyde												O		O	O	O						X	X	
Endrin ketone				O	O	O	O	O						O	O		O				O	O		O
Heptachlor				X		X		X				O		O	O						X	X		
Heptachlor epoxide				X		X	X	X		X		O	O	O	O	O	O						X	
Methoxychlor				X	X	X	X	X				O		O	O	O						X		
Polychlorinated Biphenyls																								
Total PCB Aroclors[1]	X	X		X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X

Table ES-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Metals																								
Aluminum	X			X							X	X	X	X	X	X	X	O	O	O	O	O	O	O
Antimony				O	O	O	O	O	O										X		X	X	X	
Arsenic				X										X	X	X								
Barium			O	O	O	O	O	O	O	O				X	X	X								
Beryllium			O	O	O	O	O	O	O															
Cadmium				X	X	X	X	X	X	X								X	X	X	X	X	X	X
Chromium				X	X	X			X		X	X	X	X	X	X	X	X	X		X	X	X	
Cobalt											X	X		X	X	X								
Copper				X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	
Iron			O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Lead			X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X
Manganese	X			X			X	X	X		X	X	X	X	X	X	X							
Mercury				X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Nickel				X	X	X	X	X	X					X	X	X					X			
Selenium				O	O	O	O	O	O			X	X	X	X	X			X	X	X	X	X	
Silver				X	X	X	X	X	X	X											X	X	X	
Thallium									O					X							X	X	X	
Vanadium			O	O	O	O	O	O	O	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Zinc				X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	X
Other																								
Cyanide	X			X	X	X	X	X	X	X	O	O	O	O	O	O	O		X		X			X

Notes

X = Chemical selected as a COPEC because screening-level HQ>1.

O = Chemical selected as a COPEC because no ecological screening value is available.

[1] PCBs evaluated as total PCB congeners and TCDD TEQ (PCBs) in surface water and pore water, and as total PCB Aroclors in Surface Sediment and Surface Soil.

Selection of COPECs for the various media are shown in the following tables:

Surface Water - Table 5-3

Porewater - Table 5-6

Surface Sediment - Appendix G Tables G-1 through G-8

Surface Soil (Plants and Invertebrates) - Appendix G Tables G-9 through G-15

Surface Soil (Birds and Mammals) - Appendix G Tables G-16 through G-22

Table ES-5: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Volatile Organic Chemicals																								
Acetone				X	X	X	X	X	X	X			O	O	O	O								
Benzene																								
Carbon disulfide															--									
Carbon tetrachloride															--									
Chloroform															--									
Chloroethane						O																		
Chloromethane						O									--									
Cyclohexane															O	O						O	O	
1,4-Dichlorobenzene								[2]																
cis-1,2-Dichloroethene		X				O	O	O		O					--	O						--	O	
trans-1,2-Dichloroethene																O								
1,1-Dichloroethane								--	--						--									
1,1-Dichloroethene															O									
cis-1,3-Dichloropropene															--									
trans-1,3-Dichloropropene															--									
Ethylbenzene															--	O								
2-Hexanone															O									
Methyl acetate															--							--		
Methyl ethyl ketone					--				--					O	O	O	O							
Methyl isobutyl ketone															O	O								
Methyl tert-butyl ether				--						O														
Methylcyclohexane															--							--		
Methylene chloride														O	O	O								
Tetrachloroethene								[2]																
Toluene								X																
1,2,3-Trichlorobenzene								O																
1,1,1-Trichloroethane														O	--									
Trichlorofluoromethane														O	O	O								
1,1,2-Trichloro-1,2,2-trifluoroethane								--	O															
Vinyl chloride		X						X																
m,p-Xylenes																						O		

Table ES-5: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Semi-Volatile Organic Chemicals																								
Acenaphthene				X	X	X	X	X	X	X														
Acenaphthylene				X	X	X	X	--	X															
Acetophenone				O		O	O	O		O		O		--		O	O							
Anthracene			X	X	X	X	X	X	--	X														
Benzaldehyde				O	O			O				O				O	O		O			O	O	O
Benzidine				O	O	O	O	O	O															
Benzo(a)anthracene			X	X	X	X	X	X	X	X														
Benzo(a)pyrene			X	X	X	X	X	X	X	X														
Benzo(b)fluoranthene																								
Benzo(g,h,i)perylene			X	X	X	X	X	X	X	X														
Benzoic acid						O	O	O																
Benzo(k)fluoranthene			X	X	X	X	X	X	--	X														
bis(2-Chloroethyl) ether														--										
bis(2-Chloroisopropyl) ether														--										
bis(2-Ethylhexyl) phthalate			X	X	X	X	X	X	X	X				O	O	O	O				X	X	X	X
Biphenyl																			O	O	O	--	O	O
n-Butylbenzene								O																
Butyl benzyl phthalate							--	X				--		O	O	O	O				X	X	X	
Caprolactam												O							O					
Carbazole				O	O	O	O	O	--	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Chrysene			X	X	X	X	X	X	X	X														
Dibenzo(a,h)anthracene			X	X	X	X	X	X	X	X														
Dibenzofuran											O	O	O	O	--	O	O	O	O	O	O	--	O	O
1,2-Dichlorobenzene								[2]																
1,3-Dichlorobenzene								[2]																
3,3'-Dichlorobenzidine															--									
2,4-Dimethylphenol																								
Diethylphthalate																							X	
Dimethyl phthalate												O		--		O								
di-n-Butyl phthalate						--	X	--													X	X	X	
di-n-Octyl phthalate												O		O	O	O	O							
2,6-Dinitrotoluene								--																
Fluoranthene			X	X	X	X	X	X	X	X														
Fluorene				X	X	X	X	X																
Hexachlorobenzene												O			--	O								
Indeno(1,2,3-c,d)pyrene			--	X	X	X	X	X	--	X														
p-Isopropyltouene				O			O			O														

Table ES-5: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
2-Methylnaphthalene				X	X	X	X	X				O			O	O	O							
2-Methylphenol																								
3- & 4-Methylphenol				X	X	X		X																
4-Methylphenol												O		O	--	O								
Naphthalene				X	--																			
4-Nitroaniline															--									
N-Nitrosodiphenylamine																								
Phenanthrene			X	X	X	X	X	X	--	X														
Phenol							X	--																
Pyrene			X	X	X	X	X	X	X	X														
1,2,4,5-Tetrachlorobenzene																								
LMW PAHs			[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]														
HMW PAHs			[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]		--		--	--	X		X[3]	X[3]	X[3]	X[3]	X[3]	X[3]	X[3]
Pesticides																								
Aldrin				[2]		[2]	[2]								X				O[3]		O[3]	O[3]	O[3]	O[3]
alpha-BHC				[2]	[2]	--[2]	--[2]	X[2]	[2]			O	O	O	O	O								
beta-BHC				X	X[2]	X[2]	X[2]	[2]	X[2]												O[3]	--	O[3]	
delta-BHC									[2]						O									
gamma-BHC				[2]		X[2]	X[2]	X[2]							--				O[3]			O[3]	O[3]	
Chlordane, Total				X[2]	X[2]	X[2]	X[2]	X[2]	X[2]	X[2]					--	--			O[3]		O[3]	O[3]	O[3]	O[3]
Dieldrin				X[2]		X[2]	X[2]	X[2]	X[2]			O		O	O	O	O		X[3]		X[3]	X[1,3]	X[1,3]	X[1,3]
Total DDx				X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[2]	X[2]		O		O			O		X[3]		X[3]	X[3]	X[1,3]	X[3]
alpha-Endosulfan				[2]	[2]	X[2]	X[2]					O			O	O								
beta-Endosulfan						X[2]	X[2]	X[2]	[2]					O	O	O	O					X[3]		
Endosulfan sulfate							[2]						O		O	O								
Endrin				X[2]	X[2]	X[2]	X[2]	X[2]					O	O	O									
Endrin aldehyde				[2]		[2]	[2]	[2]				O		O	O	O						--	X[3]	
Endrin ketone				O[2]	O[2]	O[2]	O[2]	O[2]						O	--		O				O[3]	--		O[3]
Heptachlor				X[2]		X[2]		--				O		O	--						X[3]	--		
Heptachlor epoxide				X[1,2]		[1,2]	X[1,2]	X[1,2]		--		O	O	O	O	O	O					[1]	X[3]	
Methoxychlor				X[2]	X[2]	X[2]	X[2]	X[2]	[2]			O		O	O	O						X[3]		
Polychlorinated Biphenyls																								
Total PCB Aroclors	X	X	[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	[1]					--	--	X	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]
TCDD TEQ (PCBs)																								

Table ES-5: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Metals																								
Aluminum	X			--							X	X	X	X	X	X	X	O	O	O	O	O	O	O
Antimony				--	O	O	O	O	--										--		X	X	X	
Arsenic	[1]		[1]	--[1,2]	--[1,2]	--[1,2]	[1,2]	[1,2]		[1]				--	--	--								
Barium			--	O	O	O	O	O	O	--				X	--	X								
Beryllium			--	O	--	O	--	O	O															
Cadmium			[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]								X[3]	X[3]	--	X[3]	X[3]	X[3]	X[3]
Chromium			[1]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	[1,2]	--[1,2]	[1]	X	X	--	X	X	X	--	X[3]	--		X[3]	X[3]	X[3]	
Cobalt											--	--		--	--	--								
Copper	[1]		[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]	--	--		X	X	X		--	--		X[3]	X[3]	X[3]	
Iron			--	O	--	--	--	O	--	--	O	O	--	O	O	O	--	O	O	--	O	O	O	--
Lead			--[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--	--		X	X	X		--	X[3]	--	X[3]	X[3]	X[3]	--
Manganese	X			--			X	--	--		--	X	--	--	X	--	--							
Mercury			[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	X[1,2]	X	X		X	X	X	--	X[3]	X[3]	--	X[3]	X[3]	X[3]	--
Nickel	[1]		[1]	X[1,2]	X[1,2]	X[1,2]	--[1]	--[1,2]	X[2]	[1]				X	--	--					--			
Selenium				O[1,2]	O[1,2]	O[1,2]	O[1,2]	O[1,2]	--[1]	[1]		X	X	X	X	X			X[3]	X[3]	X[3]	X[3]	X[3]	
Silver				X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]											X[3]	X[3]	X[3]	
Thallium									O					X							X	--	--	
Vanadium			O	O	O	O	--	O	O	--	X	X	--	--	X	X	--	X	X	--	X	X	X	--
Zinc	[1]		[1]	X[1,2]	--[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]	--	--		X	X	X		X[3]	--		X[3]	X[3]	X[3]	--
Other																								
Cyanide	X			X	X	X	X	X	X	X	O	O	O	O	O	O	O		X		--			X

Notes
X = Chemical selected as a COPEC because screening-level HQ>1.
O = Chemical selected as a COPEC because no ecological screening value is available.
-- = Chemical selected as a COPEC based on screening-level evaluation, but removed based on COPEC refinement.
[1] Chemical is evaluated in food web modeling because it is bioaccumulative and detected in biota.
[2] Chemical is evaluated in food web modeling for semi-aquatic herbivorous receptors because it is bioaccumulative and selected as a refined COPEC in Surface Sediment.
[3] Chemical is evaluated in food web modeling for terrestrial herbivorous receptors because it is bioaccumulative and selected as a refined COPEC in Surface Soil for protection of birds and mammals.
Surface Sediment - Appendix G Tables G-23 through G-30 and for herbivorous semi-aquatic receptors Appendix G Tables G-31 through G-38
Surface Soil (Plants and Invertebrates) - Appendix G Tables G-39 through G-45
Surface Soil (Birds and Mammals) - Appendix G Tables G-46 through G-52

Table ES-6: Summary of Hazard Quotients for Tissue Residue Evaluation

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Invertebrate: Asiatic Clam - Tissue																
Total PCB Aroclors	19	2	19	2	19	2	19	2	19	2	19	2	2	0.2	19	2
TCDD TEQ (PCBs) (fish)	0.01	0.001	0.01	0.001	0.01	0.001	0.01	0.001	0.0096	0.001	0.01	0.001	0.005	0.0005	0.01	0.001
Invertebrate: Crayfish - Tissue																
Total PCB Aroclors	13	1	13	1	13	1	13	1	13	1	13	1	20	2	13	1
Arsenic	37	4	37	4	37	4	37	4	37	4	37	4	--	--	37	4
Cadmium	11	1	11	1	11	1	11	1	11	1	11	1	26	3	11	1
Chromium	6	1	6	1	6	1	6	1	6	1	6	1	--	--	6	1
Copper	1	0.06	1	0.06	1	0.06	1	0.06	1	0.06	1	0.06	0.4	0.04	1	0.1
Lead	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	7	1	2	0.2
Mercury	9	1	9	1	9	1	9	1	9	1	9	0.9	11	1	9	1
Nickel	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4	--	--	4	0.4
Selenium	46	5	46	5	46	5	46	5	46	5	46	5	29	3	46	5
Silver	63	6	63	6	63	6	63	6	63	6	63	6	22	2	63	6
Zinc	27	3	27	3	27	3	27	3	27	3	27	3	22	2	27	3
Predatory Fish - Tissue																
Total DDx	0.4	0.04	0.4	0.04	0.4	0.04	0.4	0.04	1	0.07	1	0.08	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	450	45	450	45	450	45	450	45	904	90	979	98	40	4	96	10
TCDD TEQ (PCBs) (fish)	1	0.1	1	0.1	1	0.1	1	0.1	1	0.08	3	0.3	0.1	0.01	0.3	0.03
Arsenic	11	1	11	1	11	1	11	1	--	--	1	0.1	--	--	--	--
Cadmium	112	11	112	11	112	11	112	11	77	8	71	7	--	--	--	--
Chromium	--	--							--	--	--	--	--	--	--	--
Copper	6	1	6	1	6	1	6	1	5	0.5	9	1	5	1	--	--
Lead	24	2	24	2	24	2	24	2	23	2	19	2	23	2	--	--
Mercury	8	1	8	1	8	1	8	1	8	1	30	3	5	1	--	--
Nickel	--	--							--	--	--	--	--	--	--	--
Selenium	57	6	57	6	57	6	57	6	78	8	80	8	85	9	--	--
Silver	19	2	19	2	19	2	19	2	18	2	16	2	21	2	--	--
Zinc	50	5	50	5	50	5	50	5	71	7	65	6	47	5	--	--
Bottom-feeder Fish - Tissue																
Total PCB Aroclors	789	79	789	79	789	79	789	79	749	75	2674	267	891	89	926	93
TCDD TEQ (PCBs) (fish)	6	0.6	6	0.6	6	1	6	1	1	0.09	9	1	0.1	0.01	1	0
Predatory Fish - Egg Residue																
TCDD TEQ (PCBs) (fish)	0.2	0.02	0.2	0.02	0.2	0.02	0.2	0.02	0.2	0.02	0.7	0.06	0.02	0.002	0.1	0.01
Bottom-feeder Fish - Egg Residue																
TCDD TEQ (PCBs) (fish)	1	0.09	1	0.09	1	0.09	1	0.09	0.2	0.0	2	0.1	0.02	0.002	0.1	0.01
Bird Egg (Preditory Fish Tissue)																
Total DDx	0.3	0.03	0.3	0.03	0.3	0.03	0.3	0.03	0.5	0.045	0.5	0.05	--	--	--	--
Total PCB Aroclors	181	18	181	18	181	18	181	18	365	37	395	40	16	2	39	4
TCDD TEQ (PCBs) (Bird)	1,557	156	1,557	156	1,557	156	1,557	156	1,536	154	4,672	467	247	25	494	49
Bird Egg (bottom-feeder Fish Tissue)																
Total PCB Aroclors	318	32	318	32	318	32	318	32	302	30	1,078	109	359	36	373	38
TCDD TEQ (PCBs) (Bird)	6,865	686	6,865	686	6,865	686	6,865	686	1,788	179	11,925	1,193	190	19	1,446	145

Table ES-7: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Wood Duck																
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	--	--	--	--	--	--
alpha-BHC	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
beta-BHC	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
delta-BHC	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chlordane, Total	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--
alpha-Endosulfan	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--	--	--
beta-Endosulfan	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Endrin	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Endrin aldehyde	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Endrin ketone	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Heptachlor	--	--	<1	<1	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	--	--
Arsenic	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Cadmium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Chromium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	--	--	<1	<1	<1	<1	<1	<1	--	--	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	1	<1	<1	<1	1	<1	1	<1	--	--	--	--
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--

Table ES-7: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Mallard																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	2	<1	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
TCDD TEQ (PCBs)	1	<1	1	<1	<1	<1	1	<1	1	<1	<1	<1	<1	<1	1	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	1	<1	**2**	<1	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Red-Winged Blackbird																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	**13**	1	**13**	1	**13**	1	**13**	1	**13**	1	**13**	1	**8**	1	**13**	1
TCDD TEQ (PCBs)	**8**	1	**8**	1	**8**	1	**8**	1	**8**	1	**8**	1	1	<1	**8**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**9**	1	**9**	1	**9**	1	**9**	1	**9**	1	**9**	1	**7**	1	**9**	1
Lead	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	**2**	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**3**	1	**3**	1	**3**	1	**3**	1	**3**	1	**2**	<1	**3**	1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table ES-7: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Great Blue Heron																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**15**	**2**	**16**	**2**	**16**	**2**	**16**	**2**	**21**	**2**	**46**	**5**	**12**	1	**13**	1
TCDD TEQ (PCBs)	**5**	1	**5**	1	**5**	1	**5**	1	**3**	<1	**12**	1	<1	<1	**2**	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Belted Kingfisher																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**30**	**3**	**30**	**3**	**30**	**3**	**30**	**3**	**39**	**4**	**84**	**8**	**22**	**2**	**25**	**2**
TCDD TEQ (PCBs)	**11**	1	**11**	1	**11**	1	**11**	1	**6**	1	**23**	**2**	1	<1	**4**	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**2**	<1	**2**	<1	**2**	<1	**2**	<1	**2**	<1	**2**	<1	1	<1	**2**	<1
Lead	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**2**	<1	**2**	<1	**2**	<1	**2**	1	**2**	1	**2**	1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table ES-8: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB HQ		EU BB1 HQ		EU BB2 HQ		EU BB3 HQ		EU BB4 HQ		EU BB5 HQ		EU BB6 HQ		EU SL HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Muskrat																
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HMW PAHs	<1	<1	**4**	1	**3**	1	**4**	1	**2**	<1	**2**	<1	1	<1	**5**	1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	--	--	--	--	--	--
alpha-BHC	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
beta-BHC	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
delta-BHC	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chlordane, Total	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	**2**	<1	--	--	**17**	<1	1	<1	**28**	<1	**2**	<1	--	--
alpha-Endosulfan	--	--	<1	<1	<1	<1	1	<1	<1	<1	--	--	--	--	--	--
beta-Endosulfan	--	--	--	--	--	--	<1	<1	<1	<1	**5**	<1	<1	<1	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Endrin	--	--	<1	<1	1	<1	1	<1	1	<1	**3**	<1	--	--	--	--
Endrin aldehyde	--	--	<1	<1	--	--	<1	<1	<1	<1	1	<1	--	--	--	--
Endrin ketone	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Heptachlor	--	--	<1	<1	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Total PCB Aroclors	<1	<1	1	<1	1	<1	1	<1	**2**	<1	**5**	1	<1	<1	--	--
Arsenic	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Cadmium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Chromium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	--	--	<1	<1	<1	<1	<1	<1	--	--	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	--	--	**2**	<1	--	--	**2**	<1	1	<1	1	<1	1	<1	--	--

Table ES-8: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Raccoon																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	1	<1	1	<1	1	<1	1	<1	**2**	<1	1	<1	1	<1
TCDD TEQ (PCBs)	**7**	1	**7**	1	**7**	1	**7**	1	**5**	1	**8**	1	1	<1	**5**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1	1	<1
Little-Brown Bat																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**3**	<1	**5**	<1
TCDD TEQ (PCBs)	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**3**	<1	**27**	**3**
Arsenic	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	--	--	1	<1
Cadmium	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	2	<1	1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**7**	1	**7**	1	**7**	1	**7**	1	**7**	1	**7**	1	**5**	1	**7**	1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**5**	1	**5**	1	**5**	1	**5**	1	**5**	1	**3**	1	**5**	1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**2**	<1	**3**	<1

Table ES-8: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
American Mink																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**14**	**7**	**14**	**7**	**14**	**7**	**14**	**7**	**19**	**9**	**42**	**20**	**11**	**5**	**12**	**6**
TCDD TEQ (PCBs)	**39**	**4**	**39**	**4**	**39**	**4**	**39**	**4**	**11**	1	**71**	**7**	**2**	<1	**6**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	**2**	<1	**2**	<1	**2**	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table ES-9: Summary of Hazard Quotients for Food Web Modeling - Terrestrial Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB HQ		EU BB1 HQ		EU BB2 HQ		EU BB3 HQ		EU BB4 HQ		EU BB5 HQ		EU BB6 HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Mourning Dove														
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
beta-BHC	--	--	--	--	--	--	<1	<1	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	--	--	<1	<1	<1	<1	--	--
Chlordane, Total	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Endrin ketone	--	--	--	--	--	--	<1	<1	--	--	--	--	<1	<1
beta-Endosulfan	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Heptachlor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Methoxyclor	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Mercury	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Silver	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Zinc	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
American Robin														
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	**10**	1	**9**	1	**43**	**4**	**31**	**3**	**395**	**40**	**732**	**73**
Red-Tailed Hawk														
Total DDx	--	--	--	--	--	--	--	--	--	--	<1	<1	<1	<1
Dieldrin	--	--	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table ES-10: Summary of Hazard Quotients for Food Web Modeling - Terrestrial Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6	
COPEC	**HQ**		**HQ**		**HQ**		**HQ**		**HQ**		**HQ**		**HQ**	
	NOAEL	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**
Eastern Gray Squirrel														
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
beta-BHC	--	--	--	--	--	--	<1	<1	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	--	--	<1	<1	<1	<1	--	--
Chlordane, Total	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	--	--	<1	<1	<1	<1	1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	1	<1	**19**	<1	<1	<1
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Endrin ketone	--	--	--	--	--	--	<1	<1	--	--	--	--	<1	<1
beta-Endosulfan	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Heptachlor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Methoxyclor	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	--	--	--	--	1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	--	--	1	<1	<1	<1	<1	<1	--	--
Mercury	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	1	<1	<1	<1	1	<1	--	--
Silver	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Zinc	1	<1	--	--	--	--	**2**	<1	1	<1	1	<1	--	--
Short-Tailed Shrew														
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	<1	<1	**2**	<1	**2**	<1	**9**	1	**32**	**3**	**82**	**8**	**152**	**15**
Red Fox														
Total DDx	--	--	--	--	--	--	--	--	--	--	<1	<1	<1	<1
Dieldrin	--	--	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table 2-1: List of Surface Water Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample ID	Sample Location	River Mile (RM)	Notes
2011-13 Remedial Investigation	CDEOU4-20110921-SWW-GB-DNBB	Green Brook, downstream of Bound Brook	--	
	CDEOU4-20110921-SWW-BB-RM0.4	Bound Brook; Bound Brook Road (Rt 28) Bridge	0.4	
	CDEOU4-20110921-SWW-BB-RM2.2	Bound Brook; South Avenue Bridge	2.2	
	CDEOU4-20110921-SWW-BB-RM2.8	Bound Brook	2.8	(1)
	CDEOU4-20110921-SWW-BB-RM3.4	New Market Pond spillway	3.4	
	CDEOU4-20110921-SWW-BB-RM5.3	Bound Brook; Clinton Avenue Bridge	5.3	
	SW20	Downstream of the CDE OU3 groundwater model boundary.	5.8	
	CDEOU4-20110921-SWW-BB-RM6.0	Bound Brook at Manmade dam	6.0	(1)
	SW19	Downstream of Lakeview Avenue bridge.	6.15	
	SW18		6.16	
	SW17	Adjacent to the former CDE facility.	6.21	
	SW16			
	SW15		6.24	
	CDEOU4-20110921-SWW-BB-RM6.25	Walkway bridge, adjacent to former CDE facility	6.25	
	SW14	Adjacent to the former CDE facility.	6.26	
	SW13			
	SW12	Adjacent to possible discharge point.	6.29	
	SW11	Adjacent to the former CDE facility.	6.32	
	SW10		6.38	
	SW09			
	SW08		6.44	
	SW07	Upstream of CDE OU2 drainage basin.	6.48	
	SW06			
	SW05	Downstream of twin culverts.	6.54	
	SW04			
	SW03	Upstream of twin culverts (100 feet upstream).	6.57	
	SW02	Upstream of the CDE OU3 groundwater model boundary.	6.63	
	CDEOU4-20110921-SWW-BB-RM6.8	Belmont Avenue bridge	6.8	
	CDEOU4-20110921-SWW-BB-RM7.35	Bound Brook	7.35	(1)
	CDEOU4-20110921-SWW-BB-RM7.55	Downstream of Woodbrook Road Dump Superfund Site	7.68	
2011-13 Remedial Investigation	SW01	Talmadge Road bridge; upstream boundary of OU4 Study Area.	8.29	(2)
	CDEOU4-20110921-SWW-BB-RM8.3		8.3	(2)

Notes

Samples are listed by location, in order from lower to higher RM designation.

Surface water samples starting with "CDEOU4" were collected in September 2011 and were analyzed for TCL VOCs/SVOCs, TCL pesticides/PCB Aroclors, TAL metals (filtered and unfiltered), and cyanide. Other analyses (e.g., TOC, DOC, TSS, and hardness) were also performed, and water quality field measurements were collected.

Surface water samples SW01 through SW20 were collected in July-August 2012 as part of the porewater study and were analyzed for PCB congeners only.

(1) A sample of an observed groundwater seep was also collected at this location. However, seep and tributary samples collected in September 2011 were not included in data summaries for this risk assessment.

(2) Included as background/reference sample only; not included in the risk assessment data summary.

Table 2-2: List of Porewater Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample ID	Sample Location	River Mile (RM)	Notes
2011-13 Remedial Investigation	PW20	Downstream of the CDE OU3 groundwater model boundary.	5.80	(1)
	PW19	Downstream of Lakeview Avenue bridge.	6.16	(1)
	PW18			(1)
	PW17	Adjacent to the former CDE facility.	6.21	(1)
	PW16			(1)
	PW14		6.26	(1)
	PW13			(1)
	PW10		6.38	(1)
	PW09			(1)
	PW08		6.44	(2)
	PW07	Upstream of CDE OU2 drainage basin.	6.48	(1)
	PW06			(1)
	PW05	Downstream of twin culverts.	6.54	(1)
	PW04			(3)
	PW03	Upstream of twin culverts (100 feet upstream).	6.57	(1) (4)
	PW02	Upstream of the CDE OU3 groundwater model boundary.	6.63	(1)
2011-13 Remedial Investigation	PW01	Talmadge Road bridge; upstream boundary of OU4 Study Area.	8.29	(1) (5)

Notes

Samples are listed by location, in order from lower to higher RM designation.

Porewater samples were collected using passive sampling devices and were analyzed for TCL VOCs and PCB congeners. VOC passive diffusion bags were deployed for two sampling events (the same locations were occupied for each event), with the first deployment spanning 12-13 days and the second over 27-31 days. PCB polyethylene passive samplers were deployed for 33-37 days.

(1) Two depth intervals were sampled for PCB congeners.
(2) Six depth intervals were sampled for PCB congeners.
(3) Four depth intervals were sampled for PCB congeners.
(4) Duplicate samples were also collected at this location.
(5) Included as background/reference sample only; not included in the risk assessment data summary.

Table 2-3: Sediment Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Unit	River Mile (RM)	Investigation	Sampling Locations	Analytes	# Samples in each Data Set	
					Surface Sediment	All Sediment
GB	(-1.58) - 0	2011-13 Remedial Investigation	Low resolution cores at three locations	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide	7	24
BB1	0 - 3.43	1997 Ecological Evaluation (USEPA, 1999a)	Locations A7, A11, A12, and A13	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	7	7
		1997 Sediment/Soil Sampling (Weston, 1998)	Spillway Transects A through D	TCL PCB Aroclors	4	8
		2011-13 Remedial Investigation	Low resolution cores at ten locations	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide *	18	40
BB2	3.43 - 4.09	1997 Ecological Evaluation (USEPA, 1999a)	Location A6	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	2	2
		2011-13 Remedial Investigation	Low resolution cores at nine locations	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide *	9	32
BB3	4.09 - 5.22	1997 Sediment/Soil Sampling (Weston, 1998)	Transects YYY and ZZZ Transects AAAA through VVVV Bound Brook - Spring Lake South	TCL PCB Aroclors	25	45
		1997 Ecological Evaluation (USEPA, 1999a)	Locations A3, A4, and A5	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	6	6
		2011-13 Remedial Investigation	Low resolution cores at five locations	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide *	10	33
BB4	5.22 - 6.18	1997 Ecological Evaluation (USEPA, 1999a)	Location A2	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	2	2
		1997 Sediment/Soil Sampling (Weston, 1998)	Transects SS through ZZ Transects AAA and WWW Bound Brook - Bridge South, Discharge Pipe South, and Spillway South	TCL PCB Aroclors	34	58
		1999 Floodplain Soil/Sediment (Weston, 2000)	Areas 2 and 4	TCL PCB Aroclors	6	6
		2011-13 Remedial Investigation	Low resolution cores at seven locations	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide *	14	26
BB5	6.18 - 6.82	1997 Ecological Evaluation (USEPA, 1999a)	Location A1	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	6	6
		1997 Sediment/Soil Sampling (Weston, 1998)	Transects A through Z Transects AA through RR Drain adj. to Transect GG	TCL PCB Aroclors	46	67
		2007-08 Soil/Sediment Sampling (USEPA, 2008a)	Transects A through M Transects N through X Transects Y through FF Transects GG through RR	TCL PCB Aroclors	44	65
		2011-13 Remedial Investigation	Low resolution cores at nine locations	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide *	18	24
BB6	6.82 - 8.31	1997 Ecological Evaluation (USEPA, 1999a)	Location A9	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	2	2
		2007 Woodbrook Road Dump Superfund Site (TRC Environmental Corporation, 2007)	BD-001 through -006, BS-001 through BS-012, BU-001 through BU-010	TCL VOCs/SVOCs/pesticides/PCB Aroclors, and TAL metals.	28	56
		2009 Draft Site Characterization Addendum - Woodbrook Road Dump Site (TRC Environmental Corporation, 2009)	BU-010	PCB Aroclors	1	1
		2011-13 Remedial Investigation	Low resolution cores at six locations	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide	12	48
SL	NA	1997 Ecological Evaluation (USEPA, 1999a)	Location A10	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	2	2
		1999 NJDEP Spring Lake Study	Samples 15S through 32S and 19D	TCL pesticides/PCB Aroclors	18	19
		2011-13 Remedial Investigation	Low resolultion core at one location	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide	1	1
NA	NA	2011-13 Remedial Investigation	Reference Area grab sample locations in Ambrose Brook	TCL VOCs/SVOCs/pesticides/PCB Aroclors or PCB Congeners, TAL metals, and cyanide *	7	7
			Reference Area grab sample locations in Lake Nelson		3	3

Note: For this risk assessment, sediment data were separated into two data sets based on sample depth: Surface Sediment and All Sediment. Surface Sediment samples were considered any sediment sample collected from a depth starting at 0 cm. The Surface Sediment data set also included two low resolution core samples that were collected at depths of 3-16 cm and 10-14 cm below the sediment-water interface. The All Sediment data set comprises all channel sediment samples, regardless of depth.

*Select samples were also analyzed for acid-volatile sulfides and simultaneously extracted metals (AVS/SEM).

Table 2-4: Floodplain Soil Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Unit	River Mile (RM)	Investigation	Sampling Locations	Analytes	# Samples in each Data Set	
					Surface Soil	All Soil
GB	(-1.58) - 0	2011-13 Remedial Investigation	Transects 19 through 23	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide	12	24
BB1	0 - 3.43	1997 Sediment/Soil Sampling (Weston, 1998)	Spillway Transects A through D	TCL PCB Aroclors	15	25
		2011-13 Remedial Investigation	Transects 1 through 8	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide *	27	52
BB2	3.43 - 4.09	2011-13 Remedial Investigation	Transect 9	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide	2	4
BB3	4.09 - 5.22	1997 Sediment/Soil Sampling (Weston, 1998)	Transects XXX through ZZZ Transects AAAA through VVVV	TCL PCB Aroclors	107	188
		1997 Ecological Evaluation (USEPA, 1999a)	Terrestrial Sample Area T3	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	6	6
		2011-13 Remedial Investigation	Transects 10 through 13	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide *	11	22
			Grid D	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide	6	12
BB4	5.22 - 6.18	1997 Sediment/Soil Sampling (Weston, 1998)	Transects SS through ZZ Transects AAA through WWW	TCL PCB Aroclors	126	226
		1997 Ecological Evaluation (USEPA, 1999a)	Terrestrial Sample Areas T2 and T4	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	13	13
		1999 Floodplain Soil/Sediment (Weston, 2000)	Area 1 through Area 4	TCL PCB Aroclors	92	92
		2002 Veterans Memorial Park Investigation (PMK Group, 2002)	Soil borings B-1 and B-6	VOCs, SVOCs, pesticides, PCB Aroclors, and metals	0	2
			TP-10, TP-10d, TP-13, TP-33, TP-4, TP-4d, TP-6, TP-6D	BTEX, SVOCs, phenol, pesticides, PCB Aroclors, metals, mercury, and cyanide	0	8
			R-2 through R-8, R1A, R1D	PCB Aroclors	10	10
		2011-13 Remedial Investigation	Grid A and Grid B	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide	41	84
			Transects 14 and 15	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide *	5	10
			CDEOU4-SL-VMP01 through -VMP22	PCB Aroclors	22	22
BB5	6.18 - 6.82	1997 Sediment/Soil Sampling (Weston, 1998)	Drainage Ditch Transect A through Z Transect AA through RR	TCL PCB Aroclors	186	312
		1997 Ecological Evaluation (USEPA, 1999a)	Terrestrial Sample Area T1	TCL VOCs/BNAs/pesticides, PCB Aroclors, and TAL metals	8	8
		2000 Remedial Investigation (Foster Wheeler Environmental Corporation, 2002)	SS01 through SS04	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide	4	4
		2007-08 Soil/Sediment Sampling (USEPA, 2008a)	Transects A through M Transects N through X Transects Y through FF Transects GG through RR	TCL PCB Aroclors	227	341
		2011-13 Remedial Investigation	Grid C	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide	6	12
			Transect 16	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide *	3	6
BB6	6.82 - 8.31	2011-13 Remedial Investigation	Transects 17 and 18	TCL SVOCs/PCB Aroclors, TAL metals, and cyanide *	6	12
NA	NA	2011-13 Remedial Investigation	Reference Area grab sampling Ambrose Brook floodplain	TCL VOCs/SVOCs/pesticides/PCB Aroclors, TAL metals, and cyanide	5	5

Note: For this risk assessment, floodplain soil data were separated into two data sets based on sample depth: Surface Soil and All Soil. Surface Soil samples were considered any soil samples collected from depths starting between the surface (0 cm) and 30 cm below ground surface. The All Soil data set comprises all floodplain soil samples, regardless of depth. While soil samples were collected from different sampling depths, only the Surface Soil data set (*i.e.* , representative of the top 30 cm or 12 inches) was used to evaluate the potential for adverse health effects in ecological receptors.
* Select samples were also analyzed for TCL VOCs/pesticides.

Table 2-5: List of Predatory Fish Fillet Samples Included in HHRA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
August 1997 Phase III Investigation	BS-A13-1	Location A13, South Avenue bridge	2.05	bass
	BS-A13-2			bass
	PS-A13-1			pumpkinseed sunfish
	PS-A13-2			pumpkinseed sunfish
	BS-A12-1	Location A12, Prospect Street bridge	3.26	bass
	BS-A12-2			bass
	PS-A12-1			pumpkinseed sunfish
	PS-A12-2			pumpkinseed sunfish
	PS-A12-3			pumpkinseed sunfish
	BS-A11-1	Location A11, New Market Pond spillway	3.41	bass
	BS-A11-2			bass
	BS-A11-3			bass
	PS-A11-1			pumpkinseed sunfish
	PS-A11-2			pumpkinseed sunfish
	PS-A11-3			pumpkinseed sunfish
June 1997 Phase II Investigation	A6-LB-1	Location A6, West New Market Pond	3.52	bass
	A6-LB-2			bass
	A6-LB-3			bass
	A6-PS-1			pumpkinseed sunfish
	A6-PS-2			pumpkinseed sunfish
	A6-PS-3			pumpkinseed sunfish
2008/2009 USEPA Reassessment	6-BG-1	Station 6, New Market Pond	3.71	bluegill sunfish
	6-BG-2 *			bluegill sunfish
	6-BG-3			bluegill sunfish
	6-BG-4			bluegill sunfish
	6-BG-5			bluegill sunfish
June 1997 Phase II Investigation	A5-LB-1	Location A5, East New Market Pond	4.15	bass
	A5-LB-2			bass
	A5-LB-3			bass
	A5-PS-1			pumpkinseed sunfish
	A5-PS-2			pumpkinseed sunfish
	A5-PS-3			pumpkinseed sunfish
	A4-PS-1	Location A4, New Brunswick Avenue bridge	4.62	pumpkinseed sunfish
	A4-PS-2			pumpkinseed sunfish
	A4-PS-3			pumpkinseed sunfish
	A3-PS-1	Location A3, Clinton Avenue bridge	5.17	pumpkinseed sunfish
	A3-PS-2			pumpkinseed sunfish
	A3-PS-3			pumpkinseed sunfish
2008/2009 USEPA Reassessment	5-BG-1	Station 5, Clinton Avenue	5.19	bluegill sunfish
	5-BG-2			bluegill sunfish
	5-BG-3 *			bluegill sunfish
	5-P-1			pumpkinseed sunfish
	5-P-2 *			pumpkinseed sunfish
June 1997 Phase II Investigation	A2-PS-1	Location A2, below Veterans Memorial Park	5.64	pumpkinseed sunfish
	A2-PS-2			pumpkinseed sunfish
2008/2009 USEPA Reassessment	4-P-1	Station 4, Oakmoor Street	5.66	pumpkinseed sunfish
	4-P-2			pumpkinseed sunfish
	4-P-3 *			pumpkinseed sunfish
	4-P-4			pumpkinseed sunfish

Table 2-5: List of Predatory Fish Fillet Samples Included in HHRA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
2008/2009 USEPA Reassessment	3-P-1	Station 3, adjacent to former CDE facility	6.32	pumpkinseed sunfish
	3-P-2			pumpkinseed sunfish
	3-P-3 *			pumpkinseed sunfish
	3-P-4			pumpkinseed sunfish
	3-P-5			pumpkinseed sunfish
	2-P-1	Station 2, site/landfill	6.5	pumpkinseed sunfish
	2-P-2			pumpkinseed sunfish
	2-P-3 *			pumpkinseed sunfish
	2-P-4			pumpkinseed sunfish
	2-P-5			pumpkinseed sunfish
June 1997 Phase II Investigation	A1-PS-1	Location A1, adjacent to former CDE facility	6.54	pumpkinseed sunfish
	A1-PS-2			pumpkinseed sunfish
	A1-PS-3			pumpkinseed sunfish
2008/2009 USEPA Reassessment	1-P-1	Station 1, upstream of former CDE facility	7.32	pumpkinseed sunfish
	1-P-2 *			pumpkinseed sunfish
	1-P-3			pumpkinseed sunfish
	1-P-4			pumpkinseed sunfish
	1-P-5			pumpkinseed sunfish
August 1997 Phase III Investigation	BS-A10-1	Location A10	Spring Lake	bass
	BS-A10-2			bass
	BS-A10-3			bass
	PS-A10-1			pumpkinseed sunfish
	PS-A10-2			pumpkinseed sunfish
2008/2009 USEPA Reassessment	7-BG-1	Station 7		bluegill sunfish
	7-BG-2 *			bluegill sunfish
	7-BG-3			bluegill sunfish
	7-BG-4			bluegill sunfish
	7-BG-5			bluegill sunfish

Notes

Samples are listed by location, in order from lower to higher RM designation.

The June 1997 Phase II and August 1997 Phase III Investigations are both part of the USEPA 1997 Ecological Evaluation (USEPA, 1999a). Edible fish tissue samples were analyzed for TCL pesticides/PCB Aroclors and TAL metals.

Fish tissue samples collected for the USEPA 2008/2009 Reassessment (USEPA, 2010) were analyzed for % solids, % lipids, and TCL PCB Aroclors. Select samples (designated by * in this table) were also analyzed for PCB congeners.

Table 2-6: List of Bottom-Feeding Fish Fillet Samples Included in HHRA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
August 1997 Phase III Investigation	CC-A13-1 WS-A13-1 WS-A13-2 WS-A13-3	Location A13, South Avenue bridge	2.05	Carp White sucker White sucker White sucker
	BH-A12-1 CC-A12-1 CC-A12-2 CC-A12-3 WS-A12-1 WS-A12-2 WS-A12-3	Location A12, Prospect Street bridge	3.26	Brown bullhead catfish Carp Carp Carp White sucker White sucker White sucker
	BH-A11-1 BH-A11-2 BH-A11-3 CC-A11-1 CC-A11-2 CC-A11-3 WS-A11-1 WS-A11-2 WS-A11-3	Location A11, New Market Pond spillway	3.41	Brown bullhead catfish Brown bullhead catfish Brown bullhead catfish Carp Carp Carp White sucker White sucker White sucker
June 1997 Phase II Investigation	A6-CC-1 A6-CC-2 A6-CC-3	Location A6, West New Market Pond	3.52	Carp Carp Carp
2008/2009 USEPA Reassessment	6-C-1 6-C-2 6-C-3 * 6-C-4 6-C-5 6-C-6 6-C-7 6-C-8 6-WS-1 6-WS-2 * 6-WS-3	Station 6, New Market Pond	3.71	Carp Carp Carp Carp Carp Carp Carp Carp White sucker White sucker White sucker
June 1997 Phase II Investigation	A5-BH-1 A5-CC-1 A5-WS-1 A5-WS-2 A5-WS-3	Location A5, East New Market Pond	4.15	Brown bullhead catfish Carp White sucker White sucker White sucker
	A3-WS-1 A3-WS-2 A3-WS-3	Location A3, Clinton Avenue bridge	5.17	White sucker White sucker White sucker
2008/2009 USEPA Reassessment	5-WS-1 5-WS-2 5-WS-3 5-WS-4 * 5-WS-5 5-WS-6 5-WS-7 5-WS-8	Station 5, Clinton Avenue	5.19	White sucker White sucker White sucker White sucker White sucker White sucker White sucker White sucker

Table 2-6: List of Bottom-Feeding Fish Fillet Samples Included in HHRA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
June 1997 Phase II Investigation	A2-WS-1 A2-WS-2 A2-WS-3	Location A2, below Veterans Memorial Park	5.64	White sucker White sucker White sucker
2008/2009 USEPA Reassessment	4-WS-1 4-WS-2 4-WS-3 4-WS-4 4-WS-5 * 4-WS-6 4-WS-7 4-WS-8	Station 4, Oakmoor Street	5.66	White sucker White sucker White sucker White sucker White sucker White sucker White sucker White sucker
	3-WS-1 3-WS-2 3-WS-3 * 3-WS-4 3-WS-5 3-WS-6 3-WS-7 3-WS-8	Station 3, adjacent to former CDE facility	6.32	White sucker White sucker White sucker White sucker White sucker White sucker White sucker White sucker
	2-WS-1 2-WS-2 * 2-WS-3 2-WS-4 2-WS-6 * 2-WS-7	Station 2, site/landfill	6.5	White sucker White sucker White sucker White sucker White sucker (composite) White sucker (composite)
June 1997 Phase II Investigation	A1-CC-1 A1-CC-2 A1-CC-3 A1-WS-1 A1-WS-2 A1-WS-3	Location A1, adjacent to former CDE facility	6.54	Carp Carp Carp White sucker White sucker White sucker
	A9-CC-1 A9-CC-2 A9-CC-3 A9-WS-1 A9-WS-2 A9-WS-3	Location A9, original reference area upstream of former CDE facility	6.98	Carp Carp Carp White sucker White sucker White sucker
2008/2009 USEPA Reassessment	1-WS-1 1-WS-2 1-WS-3 1-WS-4 1-WS-5 * 1-WS-6 1-WS-7	Station 1, upstream of former CDE facility	7.32	White sucker White sucker White sucker White sucker White sucker White sucker White sucker

Table 2-6: List of Bottom-Feeding Fish Fillet Samples Included in HHRA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
2008/2009 USEPA Reassessment	7-C-1	Station 7	Spring Lake	Carp
	7-C-2			Carp
	7-C-3			Carp
	7-C-4			Carp
	7-C-5			Carp
	7-C-6 *			Carp
	7-C-7			Carp
	7-C-8			Carp
	7-WS-1			White sucker
	7-WS-2 *			White sucker
	7-WS-3			White sucker
August 1997 Phase III Investigation	CC-A10-1	Location A10		Carp
	CC-A10-2			Carp
	CC-A10-3			Carp
	WS-A10-1			White sucker
	WS-A10-2			White sucker
	WS-A10-3			White sucker

Notes

Samples are listed by location, in order from lower to higher RM designation.

The June 1997 Phase II and August 1997 Phase III Investigations are both part of the USEPA 1999 Ecological Evaluation (USEPA, 1999a). Edible fish tissue samples were analyzed for TCL pesticides/PCB Aroclors and TAL metals.

Fish tissue samples collected for the USEPA 2008/2009 Reassessment (USEPA, 2010) were analyzed for % solids, % lipids, and TCL PCB Aroclors. Select samples (designated by * in this table) were also analyzed for PCB congeners.

Table 2-7: List of Whole Body Predatory Fish Samples Included in ERA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
June 1997 Phase II Investigation	A6-PS-4	Location A6, West New Market Pond	3.52	pumpkinseed sunfish
	A6-PS-5			pumpkinseed sunfish
	A6-PS-6			pumpkinseed sunfish
	A6-PS-7			pumpkinseed sunfish
	A6-PS-8			pumpkinseed sunfish
	A6-PS-9			pumpkinseed sunfish
	A6-PS-10			pumpkinseed sunfish
	A6-PS-11			pumpkinseed sunfish
2008/2009 USEPA Reassessment	6-BG-1	Station 6, New Market Pond	3.71	bluegill sunfish
	6-BG-2 *			bluegill sunfish
	6-BG-3			bluegill sunfish
	6-BG-4			bluegill sunfish
	6-BG-5			bluegill sunfish
June 1997 Phase II Investigation	A5-PS-4	Location A5, East New Market Pond	4.15	pumpkinseed sunfish
	A5-PS-5			pumpkinseed sunfish
	A5-PS-6			pumpkinseed sunfish
	A5-PS-7			pumpkinseed sunfish
	A5-PS-8			pumpkinseed sunfish
	A5-PS-9			pumpkinseed sunfish
	A5-PS-10			pumpkinseed sunfish
	A4-PS-1	Location A4, New Brunswick Avenue bridge	4.62	pumpkinseed sunfish
	A4-PS-2			pumpkinseed sunfish
	A4-PS-3			pumpkinseed sunfish
	A4-PS-4			pumpkinseed sunfish
	A4-PS-5			pumpkinseed sunfish
	A4-PS-6			pumpkinseed sunfish
	A4-PS-7			pumpkinseed sunfish
	A3-PS-1	Location A3, Clinton Avenue bridge	5.17	pumpkinseed sunfish
	A3-PS-2			pumpkinseed sunfish
	A3-PS-3			pumpkinseed sunfish
	A3-PS-4			pumpkinseed sunfish
	A3-PS-5			pumpkinseed sunfish
	A3-PS-6			pumpkinseed sunfish
	A3-PS-7			pumpkinseed sunfish
	A3-PS-8			pumpkinseed sunfish
2008/2009 USEPA Reassessment	5-BG-1	Station 5, Clinton Avenue	5.19	bluegill sunfish
	5-BG-2			bluegill sunfish
	5-BG-3 *			bluegill sunfish
	5-P-1			pumpkinseed sunfish
	5-P-2 *			pumpkinseed sunfish
June 1997 Phase II Investigation	A2-PS-1	Location A2, below Veterans Memorial Park	5.64	pumpkinseed sunfish
	A2-PS-2			pumpkinseed sunfish
	A2-PS-3			pumpkinseed sunfish
	A2-PS-4			pumpkinseed sunfish
	A2-PS-5			pumpkinseed sunfish
2008/2009 USEPA Reassessment	4-P-1	Station 4, Oakmoor Street	5.66	pumpkinseed sunfish
	4-P-2			pumpkinseed sunfish
	4-P-3 *			pumpkinseed sunfish
	4-P-4			pumpkinseed sunfish

Table 2-7: List of Whole Body Predatory Fish Samples Included in ERA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
2008/2009 USEPA Reassessment	3-P-1	Station 3, adjacent to former CDE facility	6.32	pumpkinseed sunfish
	3-P-2			pumpkinseed sunfish
	3-P-3 *			pumpkinseed sunfish
	3-P-4			pumpkinseed sunfish
	3-P-5			pumpkinseed sunfish
	2-P-1	Station 2, site/landfill	6.5	pumpkinseed sunfish
	2-P-2			pumpkinseed sunfish
	2-P-3 *			pumpkinseed sunfish
	2-P-4			pumpkinseed sunfish
	2-P-5			pumpkinseed sunfish
June 1997 Phase II Investigation	A1-PS-1	Location A1, adjacent to former CDE facility	6.54	pumpkinseed sunfish
	A1-PS-2			pumpkinseed sunfish
	A1-PS-3			pumpkinseed sunfish
	A1-PS-4			pumpkinseed sunfish
	A1-PS-5			pumpkinseed sunfish
	A1-PS-6			pumpkinseed sunfish
	A9-PS-1	Location A9, original reference area upstream of former CDE facility	6.98	pumpkinseed sunfish
	A9-PS-2			pumpkinseed sunfish
	A9-PS-3			pumpkinseed sunfish
	A9-PS-4			pumpkinseed sunfish
	A9-PS-5			pumpkinseed sunfish
2008/2009 USEPA Reassessment	1-P-1	Station 1, upstream of former CDE facility	7.32	pumpkinseed sunfish
	1-P-2 *			pumpkinseed sunfish
	1-P-3			pumpkinseed sunfish
	1-P-4			pumpkinseed sunfish
	1-P-5			pumpkinseed sunfish
2008/2009 USEPA Reassessment	7-BG-1	Station 7	Spring Lake	bluegill sunfish
	7-BG-2 *			bluegill sunfish
	7-BG-3			bluegill sunfish
	7-BG-4			bluegill sunfish
	7-BG-5			bluegill sunfish

Notes

Samples are listed by location, in order from lower to higher RM designation.

The June 1997 Phase II Investigation is part of the USEPA 1999 Ecological Evaluation (USEPA, 1999a). Forage fish tissue samples were analyzed for TCL pesticides/PCB Aroclors and TAL metals.

Fish tissue samples collected for the USEPA 2008/2009 Reassessment (USEPA, 2010) were analyzed for % solids, % lipids, and TCL PCB Aroclors. Select samples (designated by * in this table) were also analyzed for PCB congeners.

Samples from the 2008/2009 Reassessment were analyzed for fillet and carcass, separately. Whole body concentrations were calculated based on the weighted fillet and carcass concentrations.

Table 2-8: List of Whole Body Bottom-Feeding Fish Samples Included in ERA
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample Name	Sample Location	River Mile (RM)	Species
2008/2009 USEPA Reassessment	6-C-1	Station 6, New Market Pond	3.71	Carp
	6-C-2			Carp
	6-C-3 *			Carp
	6-C-4			Carp
	6-C-5			Carp
	6-C-6			Carp
	6-C-7			Carp
	6-C-8			Carp
	6-WS-1			White sucker
	6-WS-2 *			White sucker
	6-WS-3			White sucker
	5-WS-1	Station 5, Clinton Avenue	5.19	White sucker
	5-WS-2			White sucker
	5-WS-3			White sucker
	5-WS-4 *			White sucker
	5-WS-5			White sucker
	5-WS-6			White sucker
	5-WS-7			White sucker
	5-WS-8			White sucker
	4-WS-1	Station 4, Oakmoor Street	5.66	White sucker
	4-WS-2			White sucker
	4-WS-3			White sucker
	4-WS-4			White sucker
	4-WS-5 *			White sucker
	4-WS-6			White sucker
	4-WS-7			White sucker
	4-WS-8			White sucker
	3-WS-1	Station 3, adjacent to former CDE facility	6.32	White sucker
	3-WS-2			White sucker
	3-WS-3 *			White sucker
	3-WS-4			White sucker
	3-WS-5			White sucker
	3-WS-6			White sucker
	3-WS-7			White sucker
	3-WS-8			White sucker
	2-WS-1	Station 2, site/landfill	6.5	White sucker
	2-WS-2 *			White sucker
	2-WS-3			White sucker
	2-WS-4			White sucker
	2-WS-6 *			White sucker (composite)
	2-WS-7			White sucker (composite)
	1-WS-1	Station 1, upstream of former CDE facility	7.32	White sucker
	1-WS-2			White sucker
	1-WS-3			White sucker
	1-WS-4			White sucker
	1-WS-5 *			White sucker
	1-WS-6			White sucker
	1-WS-7			White sucker
2008/2009 USEPA Reassessment	7-C-1	Station 7	Spring Lake	Carp
	7-C-2			Carp
	7-C-3			Carp
	7-C-4			Carp
	7-C-5			Carp
	7-C-6 *			Carp
	7-C-7			Carp
	7-C-8			Carp
	7-WS-1			White sucker
	7-WS-2 *			White sucker
	7-WS-3			White sucker

Notes

Samples are listed by location, in order from lower to higher RM designation.

Fish tissue samples collected for the USEPA 2008/2009 Reassessment (USEPA, 2010) were analyzed for % solids, % lipids, and TCL PCB Aroclors. Select samples (designated by * in this table) were also analyzed for PCB congeners.

Samples from the 2008/2009 Reassessment were analyzed for fillet and carcass, separately. Whole body

Table 2-9: List of Asiatic Clam Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample ID	# Individuals Composited	Sample Location	River Mile (RM)
2008/2009 USEPA Reassessment	5-AC-1 5-AC-2 5-AC-3 *	67 47 22	Station 5, Clinton Avenue	5.19
	4-AC-1 4-AC-2 4-AC-3 *	320 82 69	Station 4, Oakmoor Street	5.66
	3-AC-1 3-AC-2 3-AC-3 *	272 167 170	Station 3, adjacent to former CDE facility	6.32
	2-AC-1 2-AC-2 2-AC-3 *	186 79 25	Station 2, site/landfill	6.5
	1-AC-1 1-AC-2 1-AC-3 *	124 197 64	Station 1, upstream of former CDE facility	7.32

Notes

Samples are listed by location, in order from lower to higher RM designation.

Asiatic clam samples collected for the USEPA 2008/2009 Reassessment (USEPA, 2010) were analyzed for % lipids, % solids, and TCL PCB Aroclors. One sample from each station (designated by * in this table) was also analyzed for PCB congeners.

Table 2-10: List of Crayfish Samples Included in Risk Assessment
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample ID	Sample Location	River Mile (RM)
June 1997 Phase II Investigation	A5-1 A5-2 A5-3	Location A5, East New Market Pond	4.15
	A4-1 A4-2 A4-3 A4-4	Location A4, New Brunswick Avenue bridge	4.62
	A3-1 A3-2 A3-3 A3-12 A3-13 A3-14 A3-15 A3-16 A3-17 A3-18 A3-19	Location A3, Clinton Avenue bridge	5.17
	A2-2 A2-3 A2-4 A2-5 A2-10 A2-11 A2-12 A2-13	Location A2, below Veterans Memorial Park	5.64
	A1-1 A1-2	Location A1, adjacent to former CDE facility	6.54
	A9-1 A9-2 A9-3 A9-4 A9-5 A9-6 A9-7 A9-9 A9-13 A9-14	Location A9, original reference area upstream of former CDE facility	6.98

Notes
Samples are listed by location, in order from lower to higher RM designation.
The June 1997 Phase II Investigation is part of the USEPA 1997 Ecological Evaluation (USEPA, 1999a). Crayfish samples were analyzed for TCL BNAs/pesticides/PCB Aroclors and TAL metals.

Table 2-11: List of Mouse Samples Included in ERA

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sample ID	Sample Location	River Mile (RM)
June 1997 Phase II Investigation	T3-1-5 T3-1-8 T3-1-11 T3-3-15 T3-4-1 T3-4-2 T3-4-5 T3-4-20	Terrestrial Sample Area T3 (EU BB3)	4.09 - 5.22
	T2-2-7 T2-3-6 T2-4-5 T2-12-3 T2-12-8 T2-12-10	Terrestrial Sample Area T2 (EU BB4)	5.22 - 6.18
	T4-1-1 T4-1-27 T4-2-2 T4-2-7 T4-2-23 T4-2-24 T4-3-5 T4-5-3	Terrestrial Sample Area T4 (EU BB4)	
	T1-3-4 T1-5-5 T1-8-3 T1-9-7 T1-13-10 T1-10-6 T1-14-2 T1-14-6 T1-14-9 T1-14-10	Terrestrial Sample Area T1 (EU BB5)	6.18 - 6.82

Notes

Samples are listed by location, in order from lower to higher river mile designation.

The June 1997 Phase II Investigation is part of the USEPA 1997 Ecological Evaluation (USEPA, 1999a). Mouse samples were analyzed for TCL pesticides/PCB Aroclors.

Table 2-12: Summary of Sample Analytical Methods and Data Validation
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sampling Dates	Media Sampled	Analytical Fraction	Analytical Method	Analytical Laboratory	Analytical Data Validation
1997 Ecological Evaluation (USEPA, 1999a)	1997	Sediment	TCL VOCs & BNAs	SW-846 Methods 8260A, 8270A	GP Environmental	By USEPA
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080		
			TAL Metals	SW-846 Methods 6010, 7471	REAC & GP Environmental	
		Soil	TCL VOCs & BNAs	SW-846 Method 8260A, 8270A	GP Environmental	
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080		
			TAL Metals	SW-846 Methods 6010, 7471	REAC & GP Environmental	
		Fish Fillet Tissue	TCL BNAs	SW-846 Method 8270A	GP Environmental	
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080	REAC & GP Environmental	
			TAL Metals	SW-846 Methods 6010, 7471		
		Whole Body Fish Tissue	TCL BNAs	SW-846 Method 8270A	GP Environmental	
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080	REAC & GP Environmental	
			TAL Metals	SW-846 Methods 6010, 7471		
		Crayfish	TCL BNAs	SW-846 Method 8270A	GP Environmental	
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080	REAC & GP Environmental	
			TAL Metals	SW-846 Methods 6010, 7471		
		Small Mammal Tissue	TCL BNAs	SW-846 Method 8270A	GP Environmental	
			TCL PCB Aroclors & Pesticides	Modified SW-846 Method 8080		
1997 Sediment/Soil Sampling (Weston, 1998)	1997	Sediment & Soil	TCL PCB Aroclors	SW-846 Method 8082A	Chemtech Consulting Group, Englewood, NJ	Level QA-2 in accordance with Removal Program Data Validation Procedures and Region II guidelines in SOP HW-13
1999 Floodplain Soil/Sediment (Weston, 2000)	1999	Sediment & Floodplain Soil	TCL PCB Aroclors & Pesticides	USEPA SOW OLM03.2	Southwest Labs of Oklahoma, Broken Arrow, OK	By ESAT, Region 2 under the USEPA CLP following USEPA Region 2 SOP HW-6, USEPA Region II Data Validation SOP for Statement of Work OLCO 3.2, Rev. 11, June 1996
1999 NJDEP Spring Lake Study	1999	Sediment	TCL PCB Aroclors & Pesticides	USEPA SOW OLM03.2	Southwest Labs of Oklahoma, Broken Arrow, OK	By USEPA following USEPA Region 2 SOP HW-6, USEPA Region II Data Validation SOP for Statement of Work OLCO 3.2, Rev. 11, June 1996
2001 Data Evaluation Report (Foster Wheeler Environmental Corporation, 2001)	2000	Floodplain Soil	TCL VOCs & SVOCs	CLP SOWs	10 CLP Laboratories	By USEPA Region 2 Hazardous Waste Support Section
			TCL PCB Aroclors & Pesticides			
			TAL Metals & Cyanide			
			PCB Congeners	USEPA approved, generally accepted methods	EnChem Incorporated, Green Bay, WI	By Foster Wheeler personnel
			Dioxins/Furans		Triangle Laboratories Inc., Durham, NC	
2002 Veterans Memorial Park Investigation	2002	Floodplain Soil	VOCs and BTEX compounds	SW-846 Method 8260B	Chemtech Consulting Group, Mountainside, NJ	USEPA Region 2 Removal Support Team
			SVOCs	SW-846 Method 8270C		
			Phenol	USEPA Method 420.1		
			Metals	SW-846 Method 6010B		
			PCB Aroclors & Pesticides	SW-846 Methods 8081A, 8082		
			Mercury	SW-846 Method 7471		
			Cyanide	SW-846 Method 9012		

Table 2-12: Summary of Sample Analytical Methods and Data Validation
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	Sampling Dates	Media Sampled	Analytical Fraction	Analytical Method	Analytical Laboratory	Analytical Data Validation
2007 Woodbrook Road Dump Site Draft Site Characterization Report (TRC Environmental Corporation, 2007)	2007	Surface Water	TCL VOCs & SVOCs	Not available	Accutest Laboratories, Dayton, NJ	Independently according to the National Functional Guidelines and various USEPA Region 2 methods
			TCL PCB Aroclors & Pesticides	Not available		
			TAL Metals	SW-846 Method 6020A		
		Sediment	TCL VOCs & SVOCs	SW-846 Methods 8260B, 8270		
			TCL PCB Aroclors & Pesticides	SW-846 Methods 8081A, 8082		
			TAL Metals	Not available		
2007-08 Soil/Sediment Sampling (USEPA, 2008a)	2007 - 2008	Surface Water	TCL PCBs	Modified MA 1508	Mitkem Corporation, Warwick, RI	Not available
		Sediment & Soil	TCL PCB Aroclors	Not available		
		Sediment & Soil	TCL PCB Aroclors	Not available	Shealy Environmental Services, West Columbia, SC	
2010 USEPA Reassessment (USEPA, 2010)	2008	Fish Fillet Tissue	TCL PCB Aroclors	SW-846 Method 8082	PACE Analytical, Inc.	By ERT/REAC analytical chemists
			PCB Congeners	USEPA Method 1668A		
		Whole Body Fish Tissue	TCL PCB Aroclors	SW-846 Method 8082		
			PCB Congeners	USEPA Method 1668A		
		Asiatic Clam Tissue	TCL PCB Aroclors	SW-846 Method 8082		
			PCB Congeners	USEPA Method 1668A		
2009 Draft Site Characterization Addendum - Woodbrook (TRC Environmental Corporation, 2009)	2009	Sediment	PCB Aroclors	SW-846 Method 8082	Accutest Laboratories, Dayton, NJ & Alpha Woods Hole	By TRC personnel according to the National Functional Guidelines and various USEPA Region 2 methods
			PCB Congeners	Method 1668B		
			Dioxins/Furans	SW-846 Method 8290		
2011-13 Remedial Investigation	2011	Surface Water	TCL VOCs & SVOCs	USEPA CLP SOW SOM01.2	Chemtech Consulting Group, Mountainside, NJ	USEPA validators assisted by subcontractors using USEPA Region 2 validation criteria
			TCL PCB Aroclors & Pesticides			
			TAL Metals & Cyanide	USEPA CLP SOW ISM01.1	Sentinel Inc., Huntsville, AL	
		Low Res Sediment Cores & Floodplain Soil	TCL VOCs & SVOCs	USEPA CLP SOW SOM01.2	Multiple CLP Laboratories	USEPA validators assisted by subcontractors using USEPA Region 2 validation criteria
			TCL PCB Aroclors & Pesticides			
			TAL Metals & Cyanide	USEPA CLP SOW ISM01.1		
	2012	Porewater	TCL VOCs	SW-846 Method 8260B	Lancaster Laboratories, Inc., Lancaster, PA	Following USEPA National Functional Guidelines and USEPA 540/R-99/008, October 1999
			PCB Congeners	USEPA Method 1668C	Axys Analytical Services, Sidney, BC Canada	Following USEPA National Functional Guidelines and USEPA Region 2 Data Validation Standard Operating Procedure
		Surface Water	PCB Congeners			
		Sediment	PCB Congeners			
	2013	Soil	TCL PCB Aroclors	SW-846 Method 8082	Test America, Inc., South Burlington, VT	Project team validators using USEPA validation criteria including USEPA's National Functional Guidelines and USEPA Region 2 guidelines

Table 3-1: Species Observed in New Jersey Audubon Society Lower Raritan Survey
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Species Common Name	Location	Year(s) Observed at Dismal Swamp Points	Species Common Name	Location	Year(s) Observed at Dismal Swamp Points
American Crow	S, D, A	2008-2010, 2012	Northern Mockingbird	D, A	2009, 2010, 2012
American Goldfinch	S, D	2008-2010, 2012	Northern Rough-winged Swallow	D	2012
American Robin	S, D, A	2008-2010, 2012	Northern Parula	D	2008, 2012
Baltimore Oriole	D, A	2008-2010, 2012	Northern Waterthrush	S, D	2008, 2012
Barn Swallow	D, A	2008-2010, 2012	Orchard Oriole	D	2008, 2012
Belted Kingfisher	D, A	2009, 2012	Ovenbird	D	2008-2010, 2012
Black-capped Chickadee	D	2008-2010, 2012	Red-bellied Woodpecker	S, D, A	2008-2010, 2012
Blackpoll Warbler	D	2008, 2012	Red-eyed Vireo	S, D	2008-2010, 2012
Black-throated Blue Warbler	D	2012	Red-tailed Hawk	S, D, A	2008-2010, 2012
Blue Jay	S, D, A	2008-2010, 2012	Red-winged Blackbird	D, A	2008-2010, 2012
Blue-gray Gnatcatcher	D	2008-2010, 2012	Rock Dove	D	2008-2010, 2012
Brown Thrasher	D	2008, 2010, 2012	Rose-breasted Grosbeak	D	2008-2010, 2012
Brown-headed Cowbird	S, D, A	2008-2010, 2012	Ruby-throated Hummingbird	D	2008, 2009, 2012
Canada Goose	D, A	2008-2010, 2012	Scarlet Tanager	D	2008, 2012
Canada Warbler	D	2008, 2012	Song Sparrow	S, D, A	2008-2010, 2012
Carolina Wren	S, D, A	2008-2010, 2012	Swainson's Thrush	D	2008, 2012
Cedar Waxwing	D	2008-2010, 2012	Tree Swallow	D, A	2008-2010, 2012
Chimney Swift	D	2008, 2009, 2012	Tufted Titmouse	S, D, A	2008-2010, 2012
Chipping Sparrow	S, D	2009, 2010, 2012	Turkey Vulture	D, A	2010, 2012
Common Grackle	S, D, A	2008-2010, 2012	Unidentified Gull	D	2009, 2010
Common Yellowthroat	S, D, A	2008-2010, 2012	Veery	D	2008, 2012
Cooper's Hawk	D	2010, 2012	Warbling Vireo	D, A	2008-2010, 2012
Dark-eyed Junco	D	2012	White-breasted Nuthatch	D, A	2008-2010, 2012
Double-crested Cormorant	A		White-throated Sparrow	S, D	2012
Downy Woodpecker	S, D, A	2008-2010, 2012	Wild Turkey	D, A	
Eastern Bluebird	D	2012	Willow Flycatcher	D	2008-2010, 2012
Eastern Kingbird	D	2008-2010, 2012	Winter Wren	D	2012
Eastern Phoebe	S		Wood Duck	D	2008-2010, 2012
Eastern Towhee	D, A	2008-2010, 2012	Wood Thrush	S, D	2008-2010, 2012
Eastern Wood-Pewee	D	2008-2010, 2012	Worm-eating Warbler	D	2008, 2012
European Starling	S, D, A	2008-2010, 2012	Yellow Warbler	S, D, A	2008-2010, 2012
Fish Crow	D	2009, 2010, 2012	Yellow-billed Cuckoo	D	2008, 2012
Gray Catbird	S, D, A	2008-2010, 2012	Yellow-rumped Warbler	D	2012
Great Blue Heron	D, A	2008-2010, 2012	Yellow-shafted Flicker	D	2008-2010, 2012
Great Crested Flycatcher	S, D, A	2008-2010, 2012	Yellow-throated Vireo	D	2008, 2012
Great Egret	D	2008, 2009, 2012	Yellow-throated Warbler	D	2008, 2012
Green Heron	D	2008-2010, 2012			
Hairy Woodpecker	D	2008-2010, 2012			
House Finch	S, D, A	2008-2010, 2012			
House Sparrow	D	2008-2010, 2012			
House Wren	S, D, A	2008-2010, 2012			
Indigo Bunting	D	2008-2010, 2012			
Killdeer	D	2009, 2010, 2012			
Mallard	D, A	2008-2010, 2012			
Mourning Dove	S, D, A	2008-2010, 2012			
Northern Cardinal	S, D, A	2008-2010, 2012			
Northern Flicker	S, A				

Notes:

S = South Plainfield Points (five points along Bound Brook between RM5.2 and RM6.1, two points in an unnamed tributary at RM5.45, and one point in Cedar Brook upstream of Spring Lake).
D = Dismal Swamp Points (nine points between RM7.0 and RM8.3 and eight points upstream of Talmadge Road).
A = Ambrose Brook Points (five points just upstream and downstream of Lake Nelson).

Table 3-2: Summary of Potential Human Exposure Scenarios by Exposure Unit
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Scenario Timeframe	Receptor Population	Receptor Age	Exposure Medium	Exposure Unit							
				GB	BB1	BB2	BB3	BB4	BB5	BB6	SL
Current/Future	Recreationist/Sportsman	Adult & Adolescent	Surface water	√	√	√	√	√	√	√	√
			Sediment - surface	√	√	√	√	√	√	√	√
			Floodplain soil - surface	√	√	√	√	√	√	√	--
	Angler	Adult & Adolescent	Surface water	√	√	√	√	√	√	√	√
			Sediment - surface	√	√	√	√	√	√	√	√
			Floodplain soil - surface	√	√	√	√	√	√	√	--
		Adult, Adolescent & Child	Fish fillet - predatory fish	√	√	√	√	√	√	√	√
			Fish fillet - bottom-feeding fish	√	√	√	√	√	√	√	√
			Shellfish - Asiatic clams	√	√	√	√	√	√	√	√
			Shellfish - crayfish	√	√	√	√	√	√	√	--
	Outdoor Worker	Adult	Surface water	√	√	√	√	√	√	√	√
			Sediment - all	√	√	√	√	√	√	√	√
			Floodplain soil - all	√	√	√	√	√	√	√	--
	Commercial/Industrial Worker	Adult	Floodplain soil - surface	√	√	√	√	√	√	√	--
	Resident	Adult & Child	Floodplain soil - all	√	√	√	√	√	√	√	--
	Construction/Utility Worker	Adult	Floodplain soil - all	√	√	√	√	√	√	√	--

Notes
√ = Quantified exposure pathway
-- = Not applicable

Table 4-1: Bound Brook Surface Water Data from Woodbrook Road Dump Superfund Site
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Detected Chemical	Data Summary [1] Frequency of Detection	Range of Detected Concentrations (µg/L)	Screening Toxicity Value [2] (µg/L)		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]
Volatile Organic Chemicals					
cis-1,2-Dichloroethene	16 / 16	0.66 J - 1.6	2.8	n	N
Tetrachloroethylene	10 / 16	0.38 J - 0.55 J	3.5	n	N
Trichloroethene	6 / 16	0.30 J - 0.33 J	0.26	n	Y
Semi-Volatile Organic Chemicals					
Acenaphthene	1 / 16	0.017 - 0.017	40	n	N
Acenaphthylene	1 / 16	0.014 - 0.014	NA		--
Anthracene	14 / 16	0.0059 J - 0.026	130	n	N
Benzo(a)anthracene	7 / 16	0.0051 J - 0.026	0.029	c	N
Benzo(a)pyrene	6 / 16	0.0052 J - 0.028	0.0029	c	Y
Benzo(b)fluoranthene	13 / 16	0.004 J - 0.034	0.029	c	Y
Benzo(g,h,i)perylene	6 / 16	0.0054 J - 0.049	NA		--
Benzo(k)fluoranthene	6 / 16	0.0057 J - 0.033	0.29	c	N
bis-2-Ethyl(hexyl)phthalate	1 / 16	2.6 - 2.6	0.071	c	Y
Chrysene	11 / 16	0.004 J - 0.030	2.9	c	N
Dibenzo(a,h)anthracene	2 / 16	0.0062 J - 0.032	0.0029	c	Y
Fluoranthene	14 / 16	0.0088 J - 0.036	63	n	N
Fluorene	1 / 16	0.021 - 0.021	22	n	N
Indeno(1,2,3-cd)pyrene	8 / 16	0.0050 J - 0.039	0.029	c	Y
Naphthalene	9 / 16	0.0051 J - 0.0078 J	0.14	c	N
Phenanthrene	14 / 16	0.0063 J - 0.029	NA		--
Pyrene	14 / 16	0.0074 J - 0.036	8.7	n	N
Polychlorinated Biphenyls					
Total PCB Homologs	16 / 16	0.0039 J - 0.0180	0.031 [a]	n	N
Total Metals					
Aluminum	16 / 16	27 J - 180 J	1,600	n	N
Arsenic	8 / 16	1.4 J - 2.2 J	0.045	c	Y
Cadmium	16 / 16	0.34 J - 1.1 J	0.69	n	Y
Calcium	16 / 16	55,300 J - 65,900 J	NA		--
Iron	16 / 16	358 - 901	1,100	n	N
Lead	3 / 16	3.2 - 11.2	15 [b]	al	N
Magnesium	16 / 16	13,000 J - 15,250 J	NA		--
Manganese	16 / 16	191 - 357	32	n	Y
Sodium	16 / 16	36,500 J - 55,400 J	NA		--
Thallium	7 / 16	0.029 J - 0.073 J	0.016	n	Y
Zinc	11 / 16	20.3 - 33.9	470	n	N

Notes

[1] Represents data from the following samples: BD-01, BD-04, BS-01, BS-04, BS-07, BS-10 and BU-01 through BU-10, presented in Table XII of *Draft Site Characterization Summary Report, Volume I of II* (TRC Environmental Corporation, 2007).

[2] Unless otherwise noted, screening toxicity values are the USEPA Regional Screening Levels (RSL) for tapwater from May 2012 (USEPA, 2012), which are based on either a cancer risk (c) of one in a million (i.e., 10^{-6} cancer risk level) or a non-cancer (n) hazard quotient (HQ) of 1. Consistent with USEPA, Region 2 guidance, RSLs based on non-cancer effects were reduced by a factor of 10 to represent a target HQ of 0.1. Where a cancer risk-based RSL was greater than the resultant non-cancer 0.1 HQ-based RSL, the applicable screening toxicity value is the non-cancer based level.

a = Screening toxicity value is for Aroclor 1254.
b = Screening toxicity value is the drinking water action level (al) of 15 µg/L.

NA = Not Available.
Qualifier codes:
J = Estimated concentration.

Table 4-2: Bound Brook Porewater Data

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Detected Chemical	Data Summary [1] Frequency of Detection	Range of Detected Concentrations (µg/L)	Screening Toxicity Value [2] (µg/L)		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]
Volatile Organic Chemicals					
Benzene	3 / 32	0.5 J - 2 J	0.39	c	Y
Chlorobenzene	3 / 32	0.9 J - 1 J	7.2	n	N
1,4-Dichlorobenzene	6 / 32	1 J - 4 J	0.42	c	Y
1,1-Dichloroethane	8 / 32	1 J - 3 J	2.4	c	Y
1,1-Dichloroethene	8 / 32	2 J - 12 J	26	n	N
cis-1,2-Dichloroethene	26 / 32	2 J - 4,000	2.8	n	Y
trans-1,2-Dichloroethene	13 / 32	0.9 J - 19	8.6	n	Y
1,2,3-Trichlorobenzene	1 / 32	1 J	0.52	n	N
1,2,4-Trichlorobenzene	1 / 32	4 J	0.39	n	N
1,1,2-Trichloroethane	1 / 32	1 J	0.041	n	N
Trichloroethene	7 / 32	1 J - 12 J	0.26	n	Y
Vinyl chloride	22 / 32	1 J - 1,210 E	0.015	c	Y
Polychlorinated Biphenyls					
Total PCB Congeners (0-10 cm)	21 / 21	0.010 - 19	0.031	n	Y
Total PCB Congeners (all depths)	37 / 37	0.010 - 52			Y
TCDD TEQ (PCBs) (0-10 cm) [3]	19 / 19	2.2E-08 - 1.6E-06	5.2E-07	c	N
TCDD TEQ (PCBs) (all depths) [3]	33 / 33	2.2E-08 - 2.3E-05			Y

Notes

[1] Represents data from porewater samples collected in July-August 2012 during the OU4 RI (see Table 2-2). VOC passive diffusion bags were deployed for two sampling events, with the first deployment spanning 12-13 days and the second over 27-31 days. PCB polyethylene passive samplers were deployed for 33-37 days.

[2] Unless otherwise noted, screening toxicity values are the USEPA Regional Screening Levels (RSL) for tapwater from May 2012 (USEPA, 2012), which are based on either a cancer risk (c) of one in a million (i.e., 10^{-6} cancer risk level) or a non-cancer (n) hazard quotient (HQ) of 1. Consistent with USEPA, Region 2 guidance, RSLs based on non-cancer effects were reduced by a factor of 10 to represent a target HQ of 0.1. Where a cancer risk-based RSL was greater than the resultant non-cancer 0.1 HQ-based RSL, the applicable screening toxicity value is the non-cancer based level.

[3] Due to relatively high concentrations observed at PW13 and PW14 and analytical issues resolving the performance reference compounds in the passive samplers, total TCDD TEQ (PCBs) were not calculated for these two sample locations.

Qualifier codes:
J = Estimated concentration.

Table 4-3: Veterans Memorial Park Pond Sediment Data

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Detected Chemical	2002 SI Data Summary [1]		2011-2013 RI Data Summary [2]		Screening Toxicity Value [3] (mg/kg)		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]
	Frequency of Detection	Range of Detected Concentrations (mg/kg)	Frequency of Detection	Range of Detected Concentrations (mg/kg)			
Semi-volatile Organic Chemicals							
Acenaphthene	2 / 2	0.066 J - 0.15 J	Not Analyzed		340	n	N
Acenaphthylene	1 / 2	0.12 J	Not Analyzed		NA		--
Anthracene	2 / 2	0.14 J - 0.28 J	Not Analyzed		1,700	n	N
Benzo(a)anthracene	2 / 2	0.8 - 1.5	Not Analyzed		0.15	c	Y
Benzo(a)pyrene	2 / 2	1 - 1.8	Not Analyzed		0.015	c	Y
Benzo(b)fluoranthene	2 / 2	1.2 - 1.5	Not Analyzed		0.15	c	Y
Benzo(g,h,i)perylene	2 / 2	0.6 J - 0.77	Not Analyzed		NA		--
Benzo(k)fluoranthene	2 / 2	0.93 - 1.7	Not Analyzed		1.5	c	Y
bis(2-Ethylhexyl)phthalate	2 / 2	1.7 - 12 E	Not Analyzed		35	c	N
Butyl benzyl phthalate	2 / 2	0.44 - 3.3	Not Analyzed		260	c	N
Chrysene	2 / 2	1 - 1.7	Not Analyzed		15	c	N
Dibenzo(a,h)anthracene	1 / 2	0.12 J	Not Analyzed		0.015	c	Y
di-n-Butylphthalate	2 / 2	0.053 J - 0.31 J	Not Analyzed		610	n	N
di-n-Octylphthalate	2 / 2	0.067 J - 0.3 J	Not Analyzed		NA		--
Fluoranthene	2 / 2	1.4 - 2.3	Not Analyzed		230	n	N
Fluorene	1 / 2	0.093 J	Not Analyzed		230	n	N
Indeno(1,2,3-cd)pyrene	2 / 2	0.39 - 0.52 J	Not Analyzed		0.15	c	Y
Phenanthrene	2 / 2	0.49 J - 1.1	Not Analyzed		NA		--
Pyrene	2 / 2	1.4 - 2.5	Not Analyzed		170	n	N
Polychlorinated Biphenyls							
Total PCB Aroclors	2 / 2	6.7 - 7.3	3 / 3	19.5 EH - 52.6 EM	0.031	n	Y
Inorganics							
Antimony	2 / 2	1.9 B - 6.1 B	Not Analyzed		3.1	n	Y
Arsenic	2 / 2	5.8 - 12.8	Not Analyzed		0.39	c	Y
Beryllium	2 / 2	0.98 - 0.99 B	Not Analyzed		16	n	N
Cadmium	2 / 2	7.8 - 35.1	Not Analyzed		7.0	n	Y
Chromium	2 / 2	31.9 - 75.1	Not Analyzed		12,000 [a]	n	N
Copper	2 / 2	62.2 - 151	Not Analyzed		310	n	N
Lead	2 / 2	81.4 - 246 *	Not Analyzed		400	L	N
Mercury	2 / 2	0.25 *N - 0.45 *N	Not Analyzed		2.3 [b]	n	N
Nickel	2 / 2	35.9 E - 55.6 E	Not Analyzed		150 [c]	n	N
Selenium	2 / 2	0.97 - 3.1	Not Analyzed		39	n	N
Silver	2 / 2	3.2 - 5.8	Not Analyzed		39	n	N
Zinc	2 / 2	481 - 508	Not Analyzed		2,300	n	N

Notes

[1] Represents data from two surface sediment (0-15.24 cm) samples (SS-1 and SS-2) collected from a dry pond during a Site Investigation (SI) of Veterans Memorial Park in July 2002 (PMK Group, 2002).

[2] 2011-13 Remedial Investigation (RI) data are from three surface sediment (0-15 cm) samples (SD-VMP01 through SD-VMP03) collected in May 2013.

[3] The relevant screening toxicity values are the USEPA Regional Screening Levels (RSL) for Resident Soil from April 2012 (USEPA, 2012c) and are based on either a cancer (c) risk of one in a million (i.e., 10-6 cancer risk level) or a non-cancer (n) hazard quotient (HQ) of 1. Consistent with USEPA, Region 2 guidance, RSLs based on non-cancer effects were reduced by a factor of 10 to represent a target HQ of 0.1. Where a cancer risk-based RSL was greater than the resultant non-cancer 0.1 HQ-based RSL, the applicable screening toxicity value is the non-cancer based level.

a = Screening toxicity value is for Chromium III.

b = Screening toxicity value is for mercuric chloride.

c= Screening toxicity value is for nickel, soluble salts.

NA = Not Available

L = USEPA screening level for lead in residential soil

Qualifier codes:

B = For inorganics, estimated concentration.

E = For organics, concentration exceeds calibration range of GC/MS intrument.

E = For total PCBs analyzed in the 2011-13 RI samples, estimated above the contract required detection limit.

E = For inorganics, Serial dilution results not within 10%. Applicable only if analyte concentration is at least 50X the IDL in original sample.

H = Sample result is biased high.

J = Estimated concentration.

M = Sample moisture content is greater than 50%.

N = Indicates presumptive evidence of a compound.

Table 4-4: Summary of COPCs Identified in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Concern	Surface Water	Sediment																Floodplain Soil														Predatory Fish		Bottom-Feeding Fish		Invertebrates	
		Surface Sediment								All Sediment								Surface Soil							All Soil							Fish Fillet	Spring Lake	Fish Fillet	Spring Lake	Asiatic Clams	Crayfish
		GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6						
cis-1,2-Dichloroethene	X						X								X								X							X							
Vinyl chloride							X								X																						
Trichloroethene	X																																				
Acenaphthylene			X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzidine			X	X	X	X	X	X				X	X	X	X																						
Benzo(a)anthracene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(a)pyrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(b)fluoranthene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(g,h,i)perylene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Benzo(k)fluoranthene			X	X	X		X		X		X	X	X		X		X		X		X	X	X			X		X	X	X	X						
bis(2-Ethylhexyl) phthalate				X	X		X					X	X		X						X		X					X		X							
Carbazole			X	X	X	X	X		X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Chrysene																																					
Dibenzo(a,h)anthracene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
1,3-Dichlorobenzene							X								X																						
Dimethyl phthalate																			X				X			X				X	X						
di-n-Octyl phthalate				X	X	X	X					X	X	X	X				X		X	X	X	X		X		X	X	X	X						
Indeno(1,2,3-cd)pyrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
p-Isopropyltouene			X			X			X		X			X			X																				
Phenanthrene		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Aldrin																						X							X								
alpha-BHC													X																								
delta-BHC			X																			X							X								
gamma-BHC															X																						
alpha-Chlordane																																		X	X		
gamma-Chlordane																																		X	X		
Dieldrin					X		X					X	X	X	X							X	X						X	X			X		X		
4,4'-DDD																																X		X	X		
4,4'-DDE															X								X							X		X	X	X	X		
4,4'-DDT							X								X							X							X								
Endosulfan sulfate						X							X							X		X	X				X		X	X							
Endrin															X																						
Endrin aldehyde			X		X	X	X				X		X	X	X	X			X		X	X	X			X		X		X		X					
Endrin ketone			X	X	X	X	X				X			X	X						X	X		X				X		X	X						
Heptachlor epoxide							X						X	X	X								X							X		X	X	X	X		
Total PCB Aroclors / Congeners	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TCDD TEQ (PCBs)																																X	X	X	X	X	
Aluminum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Antimony							X								X						X	X	X					X	X	X							
Arsenic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		X
Cadmium				X	X	X	X	X			X	X	X	X	X	X			X		X	X	X	X				X	X	X	X						
Chromium																																					
Cobalt		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		
Copper			X								X										X	X	X					X	X	X				X			
Cyanide	X																							X							X						
Iron		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Lead								X								X					X	X	X					X	X	X	X	X	X		X		X
Manganese	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Mercury																		X			X				X			X				X	X	X	X		
Nickel											X										X							X									
Selenium																																X		X			
Silver																						X							X								
Thallium								X								X					X							X									
Vanadium		X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X		X	X	X		X	X		X	X	X							
Zinc																					X							X	X								

Table 4-5: Summary of Estimated Cancer Risks and Non-cancer Hazards - Reasonable Maximum Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Recreationist/Sportsman - Adult																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	1E-03	4E-01	2E-03	2E-01	4E-03	4E-01	2E-03	5E-01	1E-03	2E+00	8E-04	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Total per Receptor and EU	1E-05	3E-01	1E-03	7E-01	2E-03	6E-01	4E-03	9E-01	2E-03	1E+00	1E-03	3E+00	8E-04	1E+00	3E-05	3E-01
Recreationist/Sportsman - Adolescent																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	3E-04	7E-01	3E-04	4E-01	9E-04	6E-01	4E-04	7E-01	2E-04	2E+00	2E-04	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	2E+00	2E-05	3E+00	not applicable	
Total per Receptor and EU	5E-06	5E-01	3E-04	1E+00	3E-04	8E-01	9E-04	2E+00	4E-04	2E+00	3E-04	5E+00	2E-04	3E+00	8E-06	4E-01
Angler - Adult (Predatory Fish Fillet)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	1E-03	4E-01	2E-03	2E-01	4E-03	4E-01	2E-03	5E-01	1E-03	2E+00	8E-04	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Predatory fish	4E-04	2E+01	4E-04	2E+01	6E-04	3E+01	1E-03	5E+01	1E-03	5E+01	4E-03	1E+02	1E-04	5E+00	3E-04	1E+01
Total per Receptor and EU	4E-04	2E+01	2E-03	2E+01	2E-03	3E+01	5E-03	5E+01	3E-03	5E+01	5E-03	1E+02	9E-04	6E+00	3E-04	1E+01
Angler - Adult (Bottom-Feeding Fish Fillet)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	1E-03	4E-01	2E-03	2E-01	4E-03	4E-01	2E-03	5E-01	1E-03	2E+00	8E-04	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Bottom-feeding fish	5E-03	3E+02	5E-03	3E+02	8E-03	3E+02	3E-03	1E+02	3E-03	1E+02	2E-02	6E+02	2E-03	1E+02	3E-03	1E+02
Total per Receptor and EU	5E-03	3E+02	7E-03	3E+02	9E-03	3E+02	7E-03	1E+02	4E-03	1E+02	2E-02	6E+02	3E-03	1E+02	3E-03	1E+02
Angler - Adult (Asiatic Clams)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	1E-03	4E-01	2E-03	2E-01	4E-03	4E-01	2E-03	5E-01	1E-03	2E+00	8E-04	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Asiatic clams	1E-04	4E+00	1E-04	4E+00	1E-04	4E+00	1E-04	4E+00	1E-04	4E+00	1E-04	4E+00	8E-06	3E-01	1E-04	4E+00
Total per Receptor and EU	1E-04	4E+00	1E-03	5E+00	2E-03	4E+00	4E-03	5E+00	2E-03	5E+00	1E-03	7E+00	8E-04	2E+00	1E-04	4E+00
Angler - Adult (Crayfish)																
Surface water	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01	5E-06	3E-01
Sediment - surface sediment	3E-06	2E-02	1E-03	4E-01	2E-03	2E-01	4E-03	4E-01	2E-03	5E-01	1E-03	2E+00	8E-04	6E-02	3E-05	2E-02
Floodplain soil - surface soil	2E-06	4E-02	3E-06	5E-02	2E-06	4E-02	7E-06	2E-01	9E-06	2E-01	4E-05	8E-01	2E-05	1E+00	not applicable	
Crayfish	5E-05	2E+00	5E-05	2E+00	5E-05	2E+00	5E-05	2E+00	5E-05	2E+00	5E-05	2E+00	5E-05	3E+00	5E-05	2E+00
Total per Receptor and EU	6E-05	2E+00	1E-03	3E+00	2E-03	3E+00	4E-03	3E+00	2E-03	3E+00	1E-03	5E+00	9E-04	4E+00	9E-05	2E+00
Angler - Adolescent (Predatory Fish Fillet)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	3E-04	7E-01	3E-04	4E-01	9E-04	6E-01	4E-04	7E-01	2E-04	2E+00	2E-04	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	2E+00	2E-05	3E+00	not applicable	
Predatory fish	1E-04	2E+01	1E-04	2E+01	2E-04	2E+01	4E-04	5E+01	4E-04	5E+01	1E-03	1E+02	4E-05	5E+00	1E-04	1E+01
Total per Receptor and EU	1E-04	2E+01	4E-04	2E+01	6E-04	2E+01	1E-03	5E+01	8E-04	5E+01	2E-03	1E+02	2E-04	8E+00	1E-04	1E+01
Angler - Adolescent (Bottom-Feeding Fish Fillet)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	3E-04	7E-01	3E-04	4E-01	9E-04	6E-01	4E-04	7E-01	2E-04	2E+00	2E-04	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	2E+00	2E-05	3E+00	not applicable	
Bottom-feeding fish	2E-03	3E+02	2E-03	3E+02	3E-03	3E+02	1E-03	1E+02	1E-03	1E+02	7E-03	6E+02	7E-04	1E+02	1E-03	1E+02
Total per Receptor and EU	2E-03	3E+02	2E-03	3E+02	3E-03	3E+02	2E-03	1E+02	1E-03	1E+02	7E-03	6E+02	9E-04	1E+02	1E-03	1E+02
Angler - Adolescent (Asiatic Clams)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	3E-04	7E-01	3E-04	4E-01	9E-04	6E-01	4E-04	7E-01	2E-04	2E+00	2E-04	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	2E+00	2E-05	3E+00	not applicable	
Asiatic clams	4E-05	4E+00	4E-05	4E+00	4E-05	4E+00	4E-05	4E+00	4E-05	4E+00	4E-05	4E+00	3E-06	2E-01	4E-05	4E+00
Total per Receptor and EU	4E-05	4E+00	3E-04	5E+00	4E-04	4E+00	9E-04	5E+00	4E-04	5E+00	3E-04	9E+00	2E-04	4E+00	4E-05	4E+00

Table 4-5: Summary of Estimated Cancer Risks and Non-cancer Hazards - Reasonable Maximum Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Angler - Adolescent (Crayfish)																
Surface water	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01	2E-06	3E-01
Sediment - surface sediment	9E-07	5E-02	**3E-04**	7E-01	**3E-04**	4E-01	**9E-04**	6E-01	**4E-04**	7E-01	**2E-04**	**2E+00**	**2E-04**	1E-01	6E-06	5E-02
Floodplain soil - surface soil	2E-06	1E-01	2E-06	1E-01	2E-06	1E-01	6E-06	7E-01	8E-06	7E-01	4E-05	**2E+00**	2E-05	**3E+00**	not applicable	
Crayfish	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**2E+00**	2E-05	**3E+00**	2E-05	**2E+00**
Total per Receptor and EU	2E-05	**2E+00**	**3E-04**	**3E+00**	**4E-04**	**3E+00**	**9E-04**	**4E+00**	**4E-04**	**4E+00**	**3E-04**	**7E+00**	**2E-04**	**6E+00**	3E-05	**2E+00**
Angler - Child (Predatory Fish Fillet)																
Predatory fish	1E-04	**3E+01**	1E-04	**3E+01**	**2E-04**	**4E+01**	**4E-04**	**8E+01**	**4E-04**	**8E+01**	**1E-03**	**2E+02**	4E-05	**8E+00**	9E-05	**2E+01**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Bottom-Feeding Fish Fillet)																
Bottom-feeding fish	**2E-03**	**4E+02**	**2E-03**	**4E+02**	**2E-03**	**4E+02**	**8E-04**	**2E+02**	**8E-04**	**2E+02**	**6E-03**	**9E+02**	**6E-04**	**2E+02**	**8E-04**	**2E+02**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Asiatic clams)																
Asiatic clams	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	3E-05	**6E+00**	2E-06	4E-01	3E-05	**6E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Crayfish)																
Crayfish	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**3E+00**	2E-05	**4E+00**	2E-05	**3E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Outdoor Worker - Adult																
Surface water	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01	2E-07	1E-01
Sediment - all sediment	2E-07	4E-02	6E-05	2E-01	7E-05	2E-01	**2E-04**	3E-01	8E-05	2E-01	5E-05	7E-01	4E-05	8E-02	1E-06	5E-02
Floodplain soil - all soil	2E-07	1E-01	4E-07	1E-01	3E-07	1E-01	1E-06	7E-01	1E-06	5E-01	3E-06	9E-01	2E-06	1E+00	not applicable	
Total per Receptor and EU	6E-07	3E-01	6E-05	4E-01	7E-05	4E-01	**2E-04**	1E+00	8E-05	9E-01	5E-05	**2E+00**	4E-05	1E+00	1E-06	2E-01
Resident - Adult																
Floodplain soil - all soil	6E-05	3E-01	8E-05	3E-01	5E-05	3E-01	**3E-04**	**2E+00**	**2E-04**	**2E+00**	**6E-04**	**4E+00**	**4E-04**	**7E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Resident - Child																
Floodplain soil - all soil	5E-05	**2E+00**	7E-05	**2E+00**	4E-05	**2E+00**	**2E-04**	**2E+01**	**2E-04**	**2E+01**	**4E-04**	**4E+01**	**3E-04**	**6E+01**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Commercial/Industrial Worker - Adult																
Floodplain soil - surface soil	1E-05	2E-01	1E-05	2E-01	1E-05	2E-01	3E-05	1E+00	4E-05	1E+00	1E-04	**4E+00**	8E-05	**5E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Construction/Utility Worker - Adult																
Floodplain soil - all soil	4E-07	**7E+00**	5E-07	**6E+00**	4E-07	**5E+00**	1E-06	**8E+00**	1E-06	**5E+00**	4E-06	**7E+00**	2E-06	**6E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			

Notes

Cancer risks greater than 1E-04 and non-cancer hazards greater than 1E+00 are bolded and shaded.

Exposure Unit (EU) Abbreviations:
GB = Green Brook (RM -1.58 to 0)
BB1 = Bound Brook (RM 0 to 3.43)
BB2 = Bound Brook (RM 3.43 to 4.09)
BB3 = Bound Brook (RM 4.09 to 5.22)
BB4 = Bound Brook (RM 5.22 to RM 6.18)
BB5 = Bound Brook (RM 6.18 to 6.82)
BB6 = Bound Brook (RM 6.82 to RM 8.31)
SL = Spring Lake

Table 4-6: Summary of Estimated Cancer Risks and Non-cancer Hazards - Central Tendency Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Recreationist/Sportsman - Adult																
Surface water			7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01		
Sediment - surface sediment			2E-04	2E-01	2E-04	1E-01	6E-04	2E-01	2E-04	2E-01	2E-04	8E-01	1E-04	3E-02		
Floodplain soil - surface soil			3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01		
Total per Receptor and EU			2E-04	4E-01	2E-04	3E-01	6E-04	4E-01	2E-04	5E-01	2E-04	1E+00	1E-04	5E-01		
Recreationist/Sportsman - Adolescent																
Surface water			8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01		
Sediment - surface sediment			1E-04	3E-01	2E-04	2E-01	4E-04	2E-01	2E-04	3E-01	1E-04	9E-01	8E-05	5E-02		
Floodplain soil - surface soil			7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00		
Total per Receptor and EU			1E-04	5E-01	2E-04	4E-01	4E-04	7E-01	2E-04	7E-01	1E-04	2E+00	9E-05	1E+00		
Angler - Adult (Predatory Fish Fillet)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	2E-04	2E-01	2E-04	1E-01	6E-04	2E-01	2E-04	2E-01	2E-04	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Predatory fish	8E-05	2E+01	8E-05	2E+01	1E-04	2E+01	3E-04	4E+01	3E-04	4E+01	8E-04	9E+01	3E-05	4E+00	7E-05	1E+01
Total per Receptor and EU	8E-05	2E+01	3E-04	2E+01	4E-04	2E+01	9E-04	4E+01	5E-04	4E+01	1E-03	9E+01	1E-04	4E+00	7E-05	1E+01
Angler - Adult (Bottom-Feeding Fish Fillet)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	2E-04	2E-01	2E-04	1E-01	6E-04	2E-01	2E-04	2E-01	2E-04	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Bottom-feeding fish	1E-03	2E+02	1E-03	2E+02	2E-03	2E+02	6E-04	8E+01	6E-04	8E+01	4E-03	5E+02	4E-04	8E+01	6E-04	1E+02
Total per Receptor and EU	1E-03	2E+02	1E-03	2E+02	2E-03	2E+02	1E-03	8E+01	9E-04	8E+01	5E-03	5E+02	6E-04	8E+01	6E-04	1E+02
Angler - Adult (Asiatic Clams)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	2E-04	2E-01	2E-04	1E-01	6E-04	2E-01	2E-04	2E-01	2E-04	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Asiatic clams	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-06	2E-01	2E-05	3E+00
Total per Receptor and EU	2E-05	3E+00	2E-04	3E+00	3E-04	3E+00	6E-04	4E+00	3E-04	4E+00	2E-04	4E+00	1E-04	7E-01	3E-05	3E+00
Angler - Adult (Crayfish)																
Surface water	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01	7E-07	1E-01
Sediment - surface sediment	4E-07	9E-03	2E-04	2E-01	2E-04	1E-01	6E-04	2E-01	2E-04	2E-01	2E-04	8E-01	1E-04	3E-02	4E-06	9E-03
Floodplain soil - surface soil	3E-07	2E-02	3E-07	2E-02	3E-07	2E-02	8E-07	1E-01	1E-06	9E-02	5E-06	3E-01	2E-06	3E-01	not applicable	
Crayfish	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00	1E-05	2E+00
Total per Receptor and EU	1E-05	2E+00	2E-04	2E+00	2E-04	2E+00	6E-04	2E+00	3E-04	2E+00	2E-04	3E+00	1E-04	3E+00	2E-05	2E+00
Angler - Adolescent (Predatory Fish Fillet)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	2E-04	2E-01	4E-04	2E-01	2E-04	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Predatory fish	8E-05	2E+01	8E-05	2E+01	1E-04	2E+01	3E-04	4E+01	3E-04	4E+01	8E-04	9E+01	3E-05	4E+00	6E-05	1E+01
Total per Receptor and EU	8E-05	2E+01	2E-04	2E+01	3E-04	2E+01	7E-04	4E+01	4E-04	4E+01	9E-04	9E+01	1E-04	5E+00	7E-05	1E+01
Angler - Adolescent (Bottom-Feeding Fish Fillet)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	2E-04	2E-01	4E-04	2E-01	2E-04	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Bottom-feeding fish	1E-03	2E+02	1E-03	2E+02	2E-03	3E+02	6E-04	8E+01	6E-04	8E+01	4E-03	4E+02	4E-04	8E+01	6E-04	9E+01
Total per Receptor and EU	1E-03	2E+02	1E-03	2E+02	2E-03	3E+02	1E-03	8E+01	8E-04	8E+01	4E-03	4E+02	5E-04	8E+01	6E-04	9E+01
Angler - Adolescent (Asiatic Clams)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	2E-04	2E-01	4E-04	2E-01	2E-04	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Asiatic clams	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-05	3E+00	2E-06	2E-01	2E-05	3E+00
Total per Receptor and EU	2E-05	3E+00	1E-04	3E+00	2E-04	3E+00	4E-04	4E+00	2E-04	4E+00	1E-04	5E+00	9E-05	1E+00	2E-05	3E+00

Table 4-6: Summary of Estimated Cancer Risks and Non-cancer Hazards - Central Tendency Exposure
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard
Angler - Adolescent (Crayfish)																
Surface water	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01	8E-07	2E-01
Sediment - surface sediment	4E-07	3E-02	1E-04	3E-01	**2E-04**	2E-01	**4E-04**	2E-01	**2E-04**	3E-01	1E-04	9E-01	8E-05	5E-02	3E-06	2E-02
Floodplain soil - surface soil	6E-07	5E-02	7E-07	6E-02	8E-07	4E-02	2E-06	3E-01	2E-06	3E-01	1E-05	8E-01	5E-06	1E+00	not applicable	
Crayfish	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**	1E-05	**2E+00**
Total per Receptor and EU	1E-05	**2E+00**	1E-04	**2E+00**	**2E-04**	**2E+00**	**4E-04**	**2E+00**	**2E-04**	**2E+00**	1E-04	**3E+00**	1E-04	**3E+00**	2E-05	**2E+00**
Angler - Child (Predatory Fish Fillet)																
Predatory fish	8E-05	**3E+01**	8E-05	**3E+01**	1E-04	**3E+01**	**3E-04**	**6E+01**	**3E-04**	**6E+01**	**8E-04**	**1E+02**	3E-05	**6E+00**	7E-05	**2E+01**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Bottom-Feeding Fish Fillet)																
Bottom-feeding fish	**1E-03**	**4E+02**	**1E-03**	**4E+02**	**2E-03**	**4E+02**	**6E-04**	**1E+02**	**6E-04**	**1E+02**	**5E-03**	**7E+02**	**5E-04**	**1E+02**	**7E-04**	**2E+02**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Angler - Child (Asiatic clams)																
Asiatic clams	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**	2E-05	**5E+00**			2E-05	**5E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above				same as above	
Angler - Child (Crayfish)																
Crayfish	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**3E+00**	1E-05	**4E+00**	1E-05	**3E+00**
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above		same as above	
Outdoor Worker - Adult																
Surface water							6E-08	4E-02			6E-08	4E-02				
Sediment - all sediment							6E-05	1E-01			2E-05	2E-01				
Floodplain soil - all soil							3E-07	2E-01			1E-06	3E-01				
Total per Receptor and EU							6E-05	4E-01			2E-05	5E-01				
Resident - Adult																
Floodplain soil - all soil							2E-05	**2E+00**	2E-05	**2E+00**	5E-05	**3E+00**	3E-05	**5E+00**	not applicable	
Total per Receptor and EU							same as above		same as above		same as above		same as above			
Resident - Child																
Floodplain soil - all soil	4E-05	**2E+00**	6E-05	**2E+00**	3E-05	**2E+00**	**2E-04**	**2E+01**	1E-04	**2E+01**	**4E-04**	**3E+01**	**2E-04**	**4E+01**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			
Commercial/Industrial Worker - Adult																
Floodplain soil - surface soil											3E-05	**2E+00**	1E-05	**3E+00**	not applicable	
Total per Receptor and EU											same as above		same as above			
Construction/Utility Worker - Adult																
Floodplain soil - all soil	1E-07	**5E+00**	1E-07	**4E+00**	1E-07	**4E+00**	4E-07	**6E+00**	4E-07	**4E+00**	1E-06	**5E+00**	6E-07	**4E+00**	not applicable	
Total per Receptor and EU	same as above		same as above		same as above		same as above		same as above		same as above		same as above			

Notes

Cancer risks greater than 1E-04 and non-cancer hazards greater than 1E+00 are bolded and shaded.

Exposure Unit (EU) Abbreviations:
GB = Green Brook (RM -1.58 to 0)
BB1 = Bound Brook (RM 0 to 3.43)
BB2 = Bound Brook (RM 3.43 to 4.09)
BB3 = Bound Brook (RM 4.09 to 5.22)
BB4 = Bound Brook (RM 5.22 to RM 6.18)
BB5 = Bound Brook (RM 6.18 to 6.82)
BB6 = Bound Brook (RM 6.82 to RM 8.31)
SL = Spring Lake

Table 5-1: Representative Wildlife Receptors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Feeding Guild	Representative Species
Semi-Aquatic Feeding Guilds	
Herbivorous Bird	Wood duck
Insectivorous Bird	Mallard, red-winged blackbird
Piscivorous Bird	Great blue heron, belted kingfisher
Herbivorous Mammal	Muskrat
Insectivorous Mammal	Raccoon, Little brown bat
Piscivorous Mammal	Mink
Terrestrial Feeding Guilds	
Herbivorous Bird	Mourning dove
Insectivorous Bird	American robin
Carnivorous Bird	Red-tailed hawk
Herbivorous Mammal	Eastern gray squirrel
Insectivorous Mammal	Short-tailed shrew
Carnivorous Mammal	Red Fox

Table 5-2: Exposure Pathways and Measurement Endpoints
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Receptor	Assessment Endpoint	Representative Species	Exposure Routes	Measurement Endpoint(s)
Aquatic Receptors				
Benthic Invertebrates	long-term maintenance of survival, growth, and reproduction of the benthic invertebrate community	Benthic Invertebrates	Ingestion of and absorption from sediment	1-Comparison of sediment/pore water data to screening concentrations protective of benthic invertebrates 2-Comparison of benthic invertebrate tissue data to invertebrate critical body residues 3-Evaluation of sediment toxicity tests 4-Evaluation of bioaccumulation tests
Aquatic Life	long-term maintenance of survival, growth, and reproduction of the aquatic life community	Fish	Absorption from/respiration of surface water and ingestion of biota	1-Comparison of surface water/pore water data to screening concentrations protective of aquatic life 2-Comparison of fish tissue data to fish critical body residues 3-Comparison of estimated concentrations in fish eggs to critical egg residues
Semi-Aquatic Receptors				
Herbivorous Birds	long-term maintenance of the survival, growth, and reproduction of semi-aquatic bird and mammal populations within several feeding guilds that inhabit/utilize the Bound Brook corridor	Wood duck	Ingestion of and dermal contact with surface water/sediment, and ingestion of biota	1-Comparison of modeled intakes to toxicity reference values 2-Comparison of estimated concentrations in bird eggs to critical egg residues
Insectivorous Birds		Mallard, Red-winged black bird		
Piscivorous Birds		Great blue heron/Belted kingfisher		
Herbivorous Mammals		Muskrat		
Insectivorous Mammals		Raccoon, Little brown bat		
Piscivorous Mammals		Mink		

Table 5-2: Exposure Pathways and Measurement Endpoints
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Receptor	Assessment Endpoint	Representative Species	Exposure Routes	Measurement Endpoint(s)
Terrestrial Receptors				
Plants	long-term maintenance of a healthy and diverse plant community	Plants	Uptake from soil	1-Comparison of soil data to screening concentrations protective of plants
Soil Invertebrates	long-term maintenance of survival, growth, and reproduction of the soil invertebrate community	Soil Invertebrates	Ingestion of and absorption from soil	1-Comparison of soil data to screening concentrations protective of soil invertebrates 2-Evaluation of bioaccumulation tests
Herbivorous Birds Insectivorous Birds Carnivorous Birds Herbivorous Mammals Insectivorous Mammals Carnivorous Mammals	long-term maintenance of the survival, growth, and reproduction of terrestrial bird and mammal populations within several feeding guilds that inhabit/utilize the floodplains	Mourning dove American robin Red-tailed hawk Eastern gray squirrel Short-tailed shrew Red fox	Ingestion of and dermal contact with soil, ingestion of surface water, and ingestion of biota	1-Comparison of soil data to screening concentrations protective of wildlife 2-Comparison of modeled intakes to toxicity reference values

Table 5-3: Selection of COPECs in Surface Water
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical	Units	Detection Frequency [1]	Range of Detected Concentrations [1]	Location of Maximum	Upstream of OU4 Study Area (RM 8.3)	Ecological Screening Value [2]		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]	Screening-Level HQ	Identified as COPEC [Y/N]
Volatile Organic Chemicals										
2-Butanone	µg/L	2 / 11	9.4 J - 23	CDEOU4-20110921-SWW-BB-RM7.68	64	14,000	d	N	--	N
Chlorobenzene	µg/L	1 / 11	-- - 1.1 J	CDEOU4-20110921-SWF-BB-RM0.4	ND (<5)	47	c	N	--	N
cis-1,2-Dichloroethene	µg/L	3 / 11	4.4 J - 8.8	CDEOU4-20110921-SWW-BB-RM6.0; CDEOU4-20110921-SWW-BB-RM6.25	ND (<5)	590	d	N	--	N
Trichloroethene	µg/L	3 / 11	2.5 - 3.7	CDEOU4-20110921-SWW-BB-RM6.0	ND (<5)	47	c	N	--	N
Metals										
Aluminum, Total	µg/L	11 / 11	141 J - 208 J	CDEOU4-20110921-SWW-BB-RM7.68	185	87	a	Y	2	Y - HQ>1
Aluminum, Dissolved	µg/L	11 / 11	116 J - 163 J	CDEOU4-20110921-SWF-BB-RM0.4	157	87	a	Y	2	Y - HQ>1
Arsenic, Total	µg/L	11 / 11	1.9 J - 4.7 J	CDEOU4-20110921-SWF-BB-RM7.68	3.7	150	a	N	--	N
Arsenic, Dissolved	µg/L	11 / 11	3.6 J - 4.9 J	CDEOU4-20110921-SWF-BB-RM7.68	4	150	a	N	--	N
Barium, Total	µg/L	11 / 11	88.8 - 161	CDEOU4-20110921-SWF-BB-RM7.68	172	220	c	N	--	N
Barium, Dissolved	µg/L	11 / 11	90.9 - 160	CDEOU4-20110921-SWF-BB-RM7.68	177	220	c	N	--	N
Calcium, Total	µg/L	11 / 11	44,400 - 63,000	CDEOU4-20110921-SWW-BB-RM6.25	57,400	NA		--	--	N
Calcium, Dissolved	µg/L	11 / 11	44,200 - 61,700	CDEOU4-20110921-SWF-BB-RM6.8	56,200	NA		--	--	N
Copper, Total	µg/L	11 / 11	1.5 J - 2.4	CDEOU4-20110921-SWW-BB-RM0.4	1.5	13	b, e	N	--	N
Copper, Dissolved	µg/L	11 / 11	1.3 J - 2.2	CDEOU4-20110921-SWF-BB-RM5.3	1.4	13	b, e	N	--	N
Iron, Total	µg/L	8 / 11	239 - 647	CDEOU4-20110921-SWW-BB-RM6.8	207	1,000	a	N	--	N
Iron, Dissolved	µg/L	0 / 11	ND	N/A	ND (<200)	1,000	a	N	--	N
Magnesium, Total	µg/L	11 / 11	11,000 - 14,700	CDEOU4-20110921-SWF-BB-RM7.35	14,800	NA		--	--	N
Magnesium, Dissolved	µg/L	11 / 11	10,800 - 14,100	CDEOU4-20110921-SWF-BB-RM7.35	14,300	NA		--	--	N
Manganese, Total	µg/L	11 / 11	86.1 J - 277 J	CDEOU4-20110921-SWF-BB-RM6.8	198	120	d	Y	2	Y - HQ>1
Manganese, Dissolved	µg/L	11 / 11	83.3 J - 261 J	CDEOU4-20110921-SWF-BB-RM6.8	187	120	d	Y	2	Y - HQ>1
Nickel, Total	µg/L	11 / 11	2.1 J - 4.1 J	CDEOU4-20110921-SWW-BB-RM7.68	4.7	68	b, e	N	--	N
Nickel, Dissolved	µg/L	11 / 11	2.5 J - 4.2 J	CDEOU4-20110921-SWF-BB-RM7.68	5.1	68	b, e	N	--	N
Potassium, Total	µg/L	11 / 11	2,290 - 2,970	CDEOU4-20110921-SPW-BB-RM2.8	2,750	NA		--	--	N
Potassium, Dissolved	µg/L	11 / 11	2,250 J - 2,870 J	CDEOU4-20110921-SWF-BB-RM6.25	2,590	NA		--	--	N
Sodium, Total	µg/L	11 / 11	37,300 - 45,500	CDEOU4-20110921-SWF-BB-RM6.25	41,700	NA		--	--	N
Sodium, Dissolved	µg/L	11 / 11	36,700 - 44,600	CDEOU4-20110921-SWF-BB-RM6.25	41,700	NA		--	--	N
Zinc, Total	µg/L	11 / 11	2.4 - 8.7	CDEOU4-20110921-SWF-BB-RM6.0	7.8	177	b, e	N	--	N
Zinc, Dissolved	µg/L	11 / 11	2.5 - 8.2	CDEOU4-20110921-SWF-BB-RM6.0	6.4	177	b, e	N	--	N
Polychlorinated Biphenyls										
Total PCB Congeners	µg/L	19 / 19	0.0048 - 0.26	SW-14	0.0011	0.014	a	Y	19	Y - HQ>1
TCDD TEQ (PCBs) (Fish)	µg/L	19 / 19	1.5E-09 - 3.5E-08	SW-13	7.6E-10	3.0E-09	c	Y	12	Y - HQ>1
TCDD TEQ (PCBs) (Bird)	µg/L	19 / 19	1.8E-07 - 2.4E-06	SW-09	8.1E-08	3.0E-09	c	Y	809	Y - HQ>1
TCDD TEQ (PCBs) (Mammal)	µg/L	19 / 19	1.6E-08 - 4.9E-07	SW-13	1.2E-08	3.0E-09	c	Y	164	Y - HQ>1
Other										
Cyanide, Total	µg/L	11 / 11	6 J - 12.1 J	CDEOU4-20110921-SWF-BB-RM7.68	7.1	5.2	a	Y	2	Y - HQ>1
Water Chemistry										
Hardness	mg/L	11 / 11	131 - 252	CDEOU4-20110921-SWW-BB-RM2.8	180	NA		--	--	--

[1] Frequency of detection and range of detected concentrations include data from the 11 surface water sampling locations within Bound Brook downstream of the sample location at RM 8.3 (CDEOU4-20110921-SWF-BB-RM8.3) and, for PCBs, the 19 locations where passive diffusion samplers were deployed downstream of the sample location at RM 8.29.
NA = Not Available
ND = Not Detected
N/A = Not Applicable
[2] Screening values were selected based on the following hierarchy:
The lower of a and b below:
a = National Recommended Water Quality Criterion (NRWQC) (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm)
b = New Jersey Surface Water Quality Criterion (NJSWC) (N.J.A.C. 7:9B)
From the following sources, if no NRWQC or NJSWC were available:
c = New Jersey Department of Environmental Protection Ecological Screening Criterion (http://www.state.nj.us/dep/srp/guidance/ecoscreening/).
d = Tier II Secondary Chronic Value for 1,2-dichloroethene (Suter and Tsao, 1996).

e = Screening value calculated based on hardness; an average hardness of 168 mg/L in 11 surface water samples within Bound Brook was used.
Y - HQ>1 = Chemical selected as a COPEC because screening-level HQ is greater than 1.

Table 5-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Volatile Organic Chemicals																								
Acetone				X	X	X	X	X	X	X			O	O	O	O								
Benzene																								
Carbon disulfide															O									
Carbon tetrachloride															O									
Chloroform															O									
Chloroethane						O																		
Chloromethane						O									O									
Cyclohexane															O	O						O	O	
cis-1,2-Dichloroethene		X				O	O	O		O					O	O						O	O	
trans-1,2-Dichloroethene																O								
1,1-Dichloroethane								X	X						O									
1,1-Dichloroethene															O									
cis-1,3-Dichloropropene															O									
trans-1,3-Dichloropropene															O									
Ethylbenzene															O	O								
2-Hexanone															O									
Methyl acetate															O							O		
Methyl ethyl ketone					X				X					O	O	O	O							
Methyl isobutyl ketone															O	O								
Methyl tert-butyl ether				O						O														
Methylcyclohexane															O							O		
Methylene chloride														O	O	O								
Toluene								X																
1,2,3-Trichlorobenzene								O																
1,1,1-Trichloroethane														O	O									
Trichlorofluoromethane														O	O	O								
1,1,2-Trichloro-1,2,2-trifluoroethane								O	O															
Vinyl chloride		X						X																
m,p-Xylenes																						O		

Table 5-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Semi-Volatile Organic Chemicals																								
Acenaphthene				X	X	X	X	X	X	X														
Acenaphthylene				X	X	X	X	X	X															
Acetophenone				O		O	O	O		O		O		O		O	O							
Anthracene			X	X	X	X	X	X	X	X														
Benzaldehyde				O	O			O				O				O	O		O				O	O
Benzidine				O	O	O	O	O	O															
Benzo(a)anthracene			X	X	X	X	X	X	X	X														
Benzo(a)pyrene			X	X	X	X	X	X	X	X														
Benzo(b)fluoranthene																								
Benzo(g,h,i)perylene			X	X	X	X	X	X	X	X														
Benzoic acid						O	O	O																
Benzo(k)fluoranthene			X	X	X	X	X	X	X	X														
bis(2-Chloroethyl) ether														O										
bis(2-Chloroisopropyl) ether														O										
bis(2-Ethylhexyl) phthalate			X	X	X	X	X	X	X	X				O	O	O	O				X	X	X	X
Biphenyl																			O	O	O	O	O	O
n-Butylbenzene								O																
Butyl benzyl phthalate							X	X				O		O	O	O	O				X	X	X	
Caprolactam												O							O					
Carbazole				O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Chrysene			X	X	X	X	X	X	X	X														
Dibenzo(a,h)anthracene			X	X	X	X	X	X	X	X														
Dibenzofuran											O	O	O	O	O	O	O	O	O	O	O	O	O	O
3,3'-Dichlorobenzidine															O									
2,4-Dimethylphenol																								
Diethyl phthalate																							X	
Dimethyl phthalate												O		O		O								
di-n-Butyl phthalate						X	X	X													X		X	
di-n-Octyl phthalate												O		O	O	O	O							
2,6-Dinitrotoluene								X																
Fluoranthene			X	X	X	X	X	X	X	X														
Fluorene				X	X	X	X	X																
Hexachlorobenzene												O			O	O								
Indeno(1,2,3-c,d)pyrene			X	X	X	X	X	X	X	X														
p-Isopropyltouene				O			O			O														

Table 5-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
2-Methylnaphthalene				X	X	X	X	X				O			O	O	O							
2-Methylphenol																								
3- & 4-Methylphenol				X	X	X		X																
4-Methylphenol												O		O	O	O								
Naphthalene				X	X																			
4-Nitroaniline															O									
N-Nitrosodiphenylamine																								
Phenanthrene			X	X	X	X	X	X	X	X														
Phenol							X	X																
Pyrene			X	X	X	X	X	X	X	X														
1,2,4,5-Tetrachlorobenzene																								
HMW PAHs												X		X	X	X		X	X	X	X	X	X	X
Pesticides																								
Aldrin															X				O		O	O	O	O
alpha-BHC						X	X	X				O	O	O	O	O								
beta-BHC				X	X	X	X		X												O	O	O	
delta-BHC															O									
gamma-BHC						X	X	X							X				O			O	O	
Chlordane, Total				X	X	X	X	X	X	X					X	X			O		O	O	O	O
Dieldrin				X		X	X	X	X			O		O	O	O	O		X		X	X	X	X
Total DDx				X	X	X	X	X	X	X		O		O	O	O	O		X		X	X	X	X
alpha-Endosulfan						X	X					O			O	O								
beta-Endosulfan						X	X	X						O	O	O	O					X		
Endosulfan sulfate													O		O	O								
Endrin				X	X	X	X	X					O	O	O									
Endrin aldehyde												O		O	O	O						X	X	
Endrin ketone				O	O	O	O	O						O	O		O				O	O		O
Heptachlor				X		X		X				O		O	O						X	X		
Heptachlor epoxide				X		X	X	X		X		O	O	O	O	O	O						X	
Methoxychlor				X	X	X	X	X				O		O	O	O						X		
Polychlorinated Biphenyls																								
Total PCB Aroclors[1]	X	X		X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X

Table 5-4: Summary of Screening-Level Evaluation COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Porewater	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Metals																								
Aluminum	X			X							X	X	X	X	X	X	X	O	O	O	O	O	O	O
Antimony				O	O	O	O	O	O										X		X	X	X	
Arsenic				X										X	X	X								
Barium			O	O	O	O	O	O	O	O				X	X	X								
Beryllium			O	O	O	O	O	O	O															
Cadmium				X	X	X	X	X	X	X								X	X	X	X	X	X	X
Chromium				X	X	X			X		X	X	X	X	X	X	X	X	X		X	X	X	
Cobalt											X	X		X	X	X								
Copper				X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	
Iron			O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Lead			X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X
Manganese	X			X			X	X	X		X	X	X	X	X	X	X							
Mercury				X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Nickel				X	X	X	X	X	X					X	X	X					X			
Selenium				O	O	O	O	O	O			X	X	X	X	X			X	X	X	X	X	
Silver				X	X	X	X	X	X	X											X	X	X	
Thallium									O					X							X	X	X	
Vanadium			O	O	O	O	O	O	O	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Zinc				X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	X
Other																								
Cyanide	X			X	X	X	X	X	X	X	O	O	O	O	O	O	O		X		X			X

Notes

X = Chemical selected as a COPEC because screening-level HQ>1.

O = Chemical selected as a COPEC because no ecological screening value is available.

[1] PCBs evaluated as total PCB congeners and TCDD TEQ (PCBs) in surface water and pore water, and as total PCB Aroclors in Surface Sediment and Surface Soil.

Selection of COPECs for the various media are shown in the following tables:

Surface Water - Table 5-3

Porewater - Table 5-6

Surface Sediment - Appendix G Tables G-1 through G-8

Surface Soil (Plants and Invertebrates) - Appendix G Tables G-9 through G-15

Surface Soil (Birds and Mammals) - Appendix G Tables G-16 through G-22

Table 5-5: Summary of Bound Brook Surface Water Data from Woodbrook Road Dump Superfund Site
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Detected Chemical	Units	Data Summary [1]		Ecological Screening Value [2]		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]	Detected/Identified as COPEC in Bound Brook [Y/N]
		Frequency of Detection	Range of Detected Concentrations				
Volatile Organic Chemicals							
cis-1,2-Dichloroethene	µg/L	16 / 16	0.66 J - 1.6	590	d	N	Y/N
Tetrachloroethylene	µg/L	10 / 16	0.38 J - 0.55 J	45	c	N	N/N
Trichloroethene	µg/L	6 / 16	0.30 J - 0.33 J	47	c	N	N/N
Semi-Volatile Organic Chemicals							
Acenaphthene	µg/L	1 / 16	-- - 0.017	38	c	N	N/N
Acenaphthylene	µg/L	1 / 16	-- - 0.014	4,840	c	N	N/N
Anthracene	µg/L	14 / 16	0.0059 J - 0.026	0.035	c	N	N/N
Benzo(a)anthracene	µg/L	7 / 16	0.0051 J - 0.026	0.025	c	Y	N/N
Benzo(a)pyrene	µg/L	6 / 16	0.0052 J - 0.028	0.014	d	Y	N/N
Benzo(b)fluoranthene	µg/L	13 / 16	0.004 J - 0.034	9.07	c	N	N/N
Benzo(g,h,i)perylene	µg/L	6 / 16	0.0054 J - 0.049	7.64	c	N	N/N
Benzo(k)fluoranthene	µg/L	6 / 16	0.0057 J - 0.033	NA		--	N/N
bis-2-Ethyl(hexyl)phthalate	µg/L	1 / 16	-- - 2.6	0.3	c	Y	N/N
Chrysene	µg/L	11 / 16	0.004 J - 0.030	NA		--	N/N
Dibenzo(a,h)anthracene	µg/L	2 / 16	0.0062 J - 0.032	NA		--	N/N
Fluoranthene	µg/L	14 / 16	0.0088 J - 0.036	1.9	c	N	N/N
Fluorene	µg/L	1 / 16	-- - 0.021	19	c	N	N/N
Indeno(1,2,3-cd)pyrene	µg/L	8 / 16	0.0050 J - 0.039	4.31	c	N	N/N
Naphthalene	µg/L	9 / 16	0.0051 J - 0.0078 J	13	c	N	N/N
Phenanthrene	µg/L	14 / 16	0.0063 J - 0.029	3.6	c	N	N/N
Pyrene	µg/L	14 / 16	0.0074 J - 0.036	0.3	c	N	N/N
Polychlorinated Biphenyls							
Total PCB Aroclors	µg/L	16 / 16	0.0039 J - 0.018	0.014	a	Y	N/N
Total Metals							
Aluminum, Total	µg/L	16 / 16	27 J - 180 J	87	a	Y	Y/Y
Aluminum, Dissolved	µg/L	4 / 16	92 J - 150 J	87	a	Y	Y/Y
Arsenic, Total	µg/L	8 / 16	1.4 J - 2.2 J	150	a	N	Y/N
Arsenic, Dissolved	µg/L	14 / 16	1.1 J - 1.9 J	150	a	N	Y/N
Cadmium, Total	µg/L	16 / 16	0.34 J - 1.1 J	0.28	b, e	Y	N/N
Cadmium, Dissolved	µg/L	16 / 16	0.13 J 0.5 J	0.28	b, e	Y	N/N
Calcium, Total	µg/L	16 / 16	55,300 J - 65,900 J	NA		--	--
Calcium, Dissolved	µg/L	16 / 16	58,500 J - 65,700 J	NA		--	--
Iron, Total	µg/L	16 / 16	358 - 901	1,000	a	N	Y/N
Iron, Dissolved	µg/L	3 / 16	107 - 609	1,000	a	N	Y/N
Lead, Total	µg/L	3 / 16	3.2 - 11.2	5.1	a, e	Y	N/N
Lead, Dissolved	µg/L	1 / 16	-- - 3	5.1	a, e	N	N/N
Magnesium, Total	µg/L	16 / 16	13,000 J - 15,250 J	NA		--	--
Magnesium, Dissolved	µg/L	16 / 16	13,200 J - 15,250 J	NA		--	--
Manganese, Total	µg/L	16 / 16	191 - 357	120	d	Y	Y/Y
Manganese, Dissolved	µg/L	16 / 16	193 - 348	120	d	Y	Y/Y
Sodium, Total	µg/L	16 / 16	36,500 J - 55,400 J	NA		--	--
Sodium, Dissolved	µg/L	16 / 16	36,300 J - 54,400 J	NA		--	--
Thallium, Total	µg/L	7 / 16	0.029 J - 0.073 J	10	c	N	N/N
Thallium, Dissolved	µg/L	0 / 16	ND	10	c	N	N/N
Zinc, Total	µg/L	11 / 16	20.3 - 33.9	196	b, e	N	Y/N
Zinc, Dissolved	µg/L	4 / 16	22.4 - 24.5	196	b, e	N	Y/N
Water Chemistry							
Hardness	mg/L	16 / 16	162 - 215	N/A		N	--

Notes

[1] Represents data from the following samples: BD-01, BD-04, BS-01, BS-04, BS-07, BS-10 and BU-01 through BU-10, presented in Table XII of *Draft Site Characterization Summary Report, Volume I of II* (TRC Environmental Corporation, 2007).

NA = Not Available.
Qualifier codes:
J = Estimated concentration.

NA = Not Available
ND = Not Detected
N/A = Not Applicable

[2] Screening values were selected based on the following hierarchy:
The lower of a and b below:
a = National Recommended Water Quality Criterion (NRWQC) (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm)
b = New Jersey Surface Water Quality Criterion (NJSWC) (N.J.A.C. 7:9B)
From the following sources, if no NRWQC or NJSWC were available:
c = New Jersey Department of Environmental Protection Ecological Screening Criterion (http://www.state.nj.us/dep/srp/guidance/ecoscreening/).
d = Tier II Secondary Chronic Value for 1,2-dichloroethene (Suter and Tsao, 1996).
e = Screening value calculated based on hardness; an average hardness of 168 mg/L in 11 surface water samples within Bound Brook was used.

Table 5-6: Selection of COPECs in Porewater
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical	Units	Detection Frequency [1]	Range of Detected Concentrations [1]	Ecological Screening Value [2]	Max Concentration Exceeds Screening Toxicity Value ? [Y/N]	Screening-Level HQ	Identified as COPEC [Y/N]
Volatile Organic Chemicals							
Benzene	ug/L	3 / 34	0.5 J - 2 J	114 c	N	--	N
Chlorobenzene	ug/L	3 / 34	0.9 J - 1 J	47 c	N	--	N
1,4-Dichlorobenzene	ug/L	6 / 34	1 J - 4 J	9.4 c	N	--	N
1,1-Dichloroethane	ug/L	8 / 34	1 J - 3 J	47 d	N	--	N
1,1-Dichloroethene	ug/L	8 / 34	2 J - 12 J	65 c	N	--	N
cis-1,2-Dichloroethene	ug/L	27 / 34	2 J - 4,000	590 d	Y	7	Y - HQ>1
trans-1,1-Dichloroethene	ug/L	13 / 34	0.9 J - 19	970 c	N	--	N
1,2,3-Trichlorobenzene	ug/L	1 / 34	- 1 J	110 d	N	--	N
1,2,4-Trichlorobenzene	ug/L	1 / 34	- 4 J	30 c	N	--	N
1,1,2-Trichloroethane	ug/L	1 / 34	- 1 J	500 c	N	--	N
Trichloroethene	ug/L	8 / 34	1 J - 12 J	47 c	N	--	N
Vinyl chloride	ug/L	22 / 34	1 J - 1700	930 c	Y	2	Y - HQ>1
Polychlorinated Biphenyls							
Total PCB congeners (0-10 cm)	ug/L	21 / 21	0.010 - 19	0.014 a	Y	1,357	Y - HQ>1
TCDD TEQ (PCBs) (Fish) (0-10 cm)	ug/L	19 / 19	0.0000000023 - 0.00000020	0.0000000030 c	Y	65	Y - HQ>1
TCDD TEQ (PCBs) (Bird) (0-10 cm)	ug/L	19 / 19	0.00000032 - 0.000014	0.0000000030 c	Y	4,827	Y - HQ>1
TCDD TEQ (PCBs) (Mammal) (0-10 cm)	ug/L	19 / 19	0.000000022 - 0.0000016	0.0000000030 c	Y	533	Y - HQ>1

[1] Represents data from porewater samples collected in July and August 2012 during the OU4 RI (see Table 2-2). Porewater samples for VOC analysis were deployed over two 2-week periods. Porewater samples for analysis of PCB congeners were deployed over one 4-week period.

[2] Screening values were selected based on the following hierarchy:
The lower of a and b below:
a = National Recommended Water Quality Criterion (NRWQC) (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm)
b = New Jersey Surface Water Quality Criterion (NJSWC) (N.J.A.C. 7:9B)
From the following sources, if no NRWQC or NJSWC were available:
c = New Jersey Department of Environmental Protection Ecological Screening Criterion (http://www.state.nj.us/dep/srp/guidance/ecoscreening/).
d = Tier II Secondary Chronic Value for 1,2-dichloroethene (Suter and Tsao, 1996).
e = Screening value calculated based on hardness; an average hardness of 168 mg/L in 11 surface water samples within Bound Brook was used.
NA = Not Available
Y - HQ>1 = Chemical selected as a COPEC because screening-level HQ is greater than 1.
Y - NESV = Chemical selected as a COPEC because no ecological screening value is available.
Qualifier codes:
J = Estimated concentration.

Table 5-7: Veterans Memorial Park Pond Surface Sediment Data

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Detected Chemical	Historical Data Summary [1]		2011-2013 RI Data Summary [2]		Ecological Screening Value [3] (mg/kg)		Max Concentration Exceeds Screening Toxicity Value ? [Y/N]
	Frequency of Detection	Range of Detected Concentrations (mg/kg)	Frequency of Detection	Range of Detected Concentrations (mg/kg)			
Semi-volatile Organic Chemicals							
Acenaphthene	2 / 2	0.066 J - 0.15 J	Not Analyzed		0.00671	b	Y
Acenaphthylene	1 / 2	0.12 J	Not Analyzed		0.00587	b	Y
Anthracene	2 / 2	0.14 J - 0.28 J	Not Analyzed		0.0572	a	Y
Benzo(a)anthracene	2 / 2	0.8 - 1.5	Not Analyzed		0.108	a	Y
Benzo(a)pyrene	2 / 2	1 - 1.8	Not Analyzed		0.15	a	Y
Benzo(b)fluoranthene	2 / 2	1.2 - 1.5	Not Analyzed		10.4	b	N
Benzo(g,h,i)perylene	2 / 2	0.6 J - 0.77	Not Analyzed		0.17	b	Y
Benzo(k)fluoranthene	2 / 2	0.93 - 1.7	Not Analyzed		0.24	b	Y
bis(2-Ethylhexyl)phthalate	2 / 2	1.7 - 12 E	Not Analyzed		0.182	b	Y
Butyl benzyl phthalate	2 / 2	0.44 - 3.3	Not Analyzed		1.97	b	Y
Chrysene	2 / 2	1 - 1.7	Not Analyzed		0.166	a	Y
Dibenzo(a,h)anthracene	1 / 2	0.12 J	Not Analyzed		0.033	b	Y
di-n-Butylphthalate	2 / 2	0.053 J - 0.31 J	Not Analyzed		1.114	b	N
di-n-Octylphthalate	2 / 2	0.067 J - 0.3 J	Not Analyzed		40.6	b	N
Fluoranthene	2 / 2	1.4 - 2.3	Not Analyzed		0.423	a	Y
Fluorene	1 / 2	0.093 J	Not Analyzed		0.0774	a	Y
Indeno(1,2,3-cd)pyrene	2 / 2	0.39 - 0.52 J	Not Analyzed		0.2	b	Y
Phenanthrene	2 / 2	0.49 J - 1.1	Not Analyzed		0.204	a	Y
Pyrene	2 / 2	1.4 - 2.5	Not Analyzed		0.195	a	Y
Polychlorinated Biphenyls							
Total PCB Aroclors	2 / 2	6.7 - 7.3	3 / 3	20.2 - 52.6	0.0598	a	Y
Inorganics							
Antimony	2 / 2	1.9 B - 6.1 B	Not Analyzed		NA		--
Arsenic	2 / 2	5.8 - 12.8	Not Analyzed		9.79	a	Y
Beryllium	2 / 2	0.98 - 0.99 B	Not Analyzed		NA		--
Cadmium	2 / 2	7.8 - 35.1	Not Analyzed		0.99	a	Y
Chromium	2 / 2	31.9 - 75.1	Not Analyzed		43.4	a	Y
Copper	2 / 2	62.2 - 151	Not Analyzed		31.6	a	Y
Lead	2 / 2	81.4 - 246 *	Not Analyzed		35.8	a	Y
Mercury	2 / 2	0.25 *N - 0.45 *N	Not Analyzed		0.18	a	Y
Nickel	2 / 2	35.9 E - 55.6 E	Not Analyzed		22.7	a	Y
Selenium	2 / 2	0.97 - 3.1	Not Analyzed		NA		--
Silver	2 / 2	3.2 - 5.8	Not Analyzed		0.5	b	Y
Zinc	2 / 2	481 - 508	Not Analyzed		121	a	Y

Notes

[1] Historical data are from two surface sediment (0-15.24 cm) samples (SS-1 and SS-2) collected in July 2002 during the Veterans Memorial Park Investigation (PMK Group, 2002).

[2] 2011-13 Remedial Investigation (RI) data are from three surface sediment (0-15 cm) samples (SD-VMP01 through SD-VMP03) collected in May 2013.

[3] Screening values were selected based on the following hierarchy

a = Consensus-based sediment quality guidelines, threshold effects concentrations (MacDonald, 2000)

b = USEPA Region 5 Ecological Screening Levels for sediment (accessed online at: http://www.epa.gov/reg5rcra/ca/edql.htm)

c = NJDEP Site Remediation Program Ecological Screening Criteria for sediment (accessed online at: http://www.nj.gov/dep/srp/guidance/ecoscreening/

NA = Not Available

Qualifier codes:

B = For inorganics, estimated concentration.

E = For organics, concentration exceeds calibration range of GC/MS intrument.

E = For inorganics, Serial dilution results not within 10%. Applicable only if analyte concentration is at least 50X the IDL in original sample.

J = Estimated concentration.

N = Indicates presumptive evidence of a compound.

Table 5-8: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Volatile Organic Chemicals																								
Acetone				X	X	X	X	X	X	X			O	O	O	O								
Benzene																								
Carbon disulfide															--									
Carbon tetrachloride															--									
Chloroform															--									
Chloroethane						O																		
Chloromethane						O									--									
Cyclohexane															O	O						O	O	
1,4-Dichlorobenzene								[2]																
cis-1,2-Dichloroethene		X				O	O	O		O					--	O						--	O	
trans-1,2-Dichloroethene																O								
1,1-Dichloroethane								--	--						--									
1,1-Dichloroethene															O									
cis-1,3-Dichloropropene															--									
trans-1,3-Dichloropropene															--									
Ethylbenzene															--	O								
2-Hexanone															O									
Methyl acetate															--							--		
Methyl ethyl ketone					--				--					O	O	O	O							
Methyl isobutyl ketone															O	O								
Methyl tert-butyl ether				--						O														
Methylcyclohexane															--							--		
Methylene chloride														O	O	O								
Tetrachloroethene								[2]																
Toluene								X																
1,2,3-Trichlorobenzene								O																
1,1,1-Trichloroethane														O	--									
Trichlorofluoromethane														O	O	O								
1,1,2-Trichloro-1,2,2-trifluoroethane								--	O															
Vinyl chloride		X						X																
m,p-Xylenes																						O		

Table 5-8: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Semi-Volatile Organic Chemicals																								
Acenaphthene				X	X	X	X	X	X	X														
Acenaphthylene				X	X	X	X	--	X															
Acetophenone				O		O	O	O		O		O		--		O	O							
Anthracene			X	X	X	X	X	X	--	X														
Benzaldehyde				O	O			O				O				O	O		O			O	O	O
Benzidine				O	O	O	O	O	O															
Benzo(a)anthracene			X	X	X	X	X	X	X	X														
Benzo(a)pyrene			X	X	X	X	X	X	X	X														
Benzo(b)fluoranthene																								
Benzo(g,h,i)perylene			X	X	X	X	X	X	X	X														
Benzoic acid						O	O	O																
Benzo(k)fluoranthene			X	X	X	X	X	X	--	X														
bis(2-Chloroethyl) ether														--										
bis(2-Chloroisopropyl) ether														--										
bis(2-Ethylhexyl) phthalate			X	X	X	X	X	X	X	X				O	O	O	O				X	X	X	X
Biphenyl																			O	O	O	--	O	O
n-Butylbenzene								O																
Butyl benzyl phthalate							--	X				--		O	O	O	O				X	X	X	
Caprolactam												O							O					
Carbazole				O	O	O	O	O	--	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Chrysene			X	X	X	X	X	X	X	X														
Dibenzo(a,h)anthracene			X	X	X	X	X	X	X	X														
Dibenzofuran											O	O	O	O	--	O	O	O	O	O	O	--	O	O
1,2-Dichlorobenzene								[2]																
1,3-Dichlorobenzene								[2]																
3,3'-Dichlorobenzidine															--									
2,4-Dimethylphenol																								
Diethylphthalate																							X	
Dimethyl phthalate												O		--		O								
di-n-Butyl phthalate						--	X	--													X	X	X	
di-n-Octyl phthalate												O		O	O	O	O							
2,6-Dinitrotoluene								--																
Fluoranthene			X	X	X	X	X	X	X	X														
Fluorene				X	X	X	X	X																
Hexachlorobenzene												O			--	O								
Indeno(1,2,3-c,d)pyrene			--	X	X	X	X	X	--	X														
p-Isopropyltouene				O			O			O														

Table 5-8: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
2-Methylnaphthalene				X	X	X	X	X				O			O	O	O							
2-Methylphenol																								
3- & 4-Methylphenol				X	X	X		X																
4-Methylphenol												O		O	--	O								
Naphthalene				X	--																			
4-Nitroaniline															--									
N-Nitrosodiphenylamine																								
Phenanthrene			X	X	X	X	X	X	--	X														
Phenol							X	--																
Pyrene			X	X	X	X	X	X	X	X														
1,2,4,5-Tetrachlorobenzene																								
LMW PAHs			[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]														
HMW PAHs			[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]		--		--	--	X		X[3]	X[3]	X[3]	X[3]	X[3]	X[3]	X[3]
Pesticides																								
Aldrin				[2]		[2]	[2]								X				O[3]		O[3]	O[3]	O[3]	O[3]
alpha-BHC				[2]	[2]	--[2]	--[2]	X[2]	[2]			O	O	O	O	O								
beta-BHC				X	X[2]	X[2]	X[2]	[2]	X[2]												O[3]	--	O[3]	
delta-BHC									[2]						O									
gamma-BHC				[2]		X[2]	X[2]	X[2]							--				O[3]			O[3]	O[3]	
Chlordane, Total				X[2]	X[2]	X[2]	X[2]	X[2]	X[2]	X[2]					--	--			O[3]		O[3]	O[3]	O[3]	O[3]
Dieldrin				X[2]		X[2]	X[2]	X[2]	X[2]			O		O	O	O	O		X[3]		X[3]	X[1,3]	X[1,3]	X[1,3]
Total DDx				X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[2]	X[2]		O		O			O		X[3]		X[3]	X[3]	X[1,3]	X[3]
alpha-Endosulfan				[2]	[2]	X[2]	X[2]					O			O	O								
beta-Endosulfan						X[2]	X[2]	X[2]	[2]					O	O	O	O					X[3]		
Endosulfan sulfate							[2]						O		O	O								
Endrin				X[2]	X[2]	X[2]	X[2]	X[2]					O	O	O									
Endrin aldehyde				[2]		[2]	[2]	[2]				O		O	O	O						--	X[3]	
Endrin ketone				O[2]	O[2]	O[2]	O[2]	O[2]						O	--		O				O[3]	--		O[3]
Heptachlor				X[2]		X[2]		--				O		O	--						X[3]	--		
Heptachlor epoxide				X[1,2]		[1,2]	X[1,2]	X[1,2]		--		O	O	O	O	O	O					[1]	X[3]	
Methoxychlor				X[2]	X[2]	X[2]	X[2]	X[2]	[2]			O		O	O	O						X[3]		
Polychlorinated Biphenyls																								
Total PCB Aroclors	X	X	[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	[1]					--	--	X	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]	X[1,3]
TCDD TEQ (PCBs)																								

Table 5-8: Summary of Refined COPECs in Each Exposure Medium
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern (COPEC)	Surface Water	Pore Water	Sediment								Floodplain Soil													
			Surface Sediment								Surface Soil - Plants and Invertebrates							Surface Soil - Birds and Mammals						
			GB	BB1	BB2	BB3	BB4	BB5	BB6	SL	GB	BB1	BB2	BB3	BB4	BB5	BB6	GB	BB1	BB2	BB3	BB4	BB5	BB6
Metals																								
Aluminum	X			--							X	X	X	X	X	X	X	O	O	O	O	O	O	O
Antimony				--	O	O	O	O	--										--		X	X	X	
Arsenic	[1]		[1]	--[1,2]	--[1,2]	--[1,2]	[1,2]	[1,2]		[1]				--	--	--								
Barium			--	O	O	O	O	O	O	--				X	--	X								
Beryllium			--	O	--	O	--	O	O															
Cadmium			[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]								X[3]	X[3]	--	X[3]	X[3]	X[3]	X[3]
Chromium			[1]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	[1,2]	--[1,2]	[1]	X	X	--	X	X	X	--	X[3]	--		X[3]	X[3]	X[3]	
Cobalt											--	--		--	--	--								
Copper	[1]		[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]	--	--		X	X	X		--	--		X[3]	X[3]	X[3]	
Iron			--	O	--	--	--	O	--	--	O	O	--	O	O	O	--	O	O	--	O	O	O	--
Lead			--[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--	--		X	X	X		--	X[3]	--	X[3]	X[3]	X[3]	--
Manganese	X			--			X	--	--		--	X	--	--	X	--	--							
Mercury			[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	--[1,2]	X[1,2]	X	X		X	X	X	--	X[3]	X[3]	--	X[3]	X[3]	X[3]	--
Nickel	[1]		[1]	X[1,2]	X[1,2]	X[1,2]	--[1]	--[1,2]	X[2]	[1]				X	--	--					--			
Selenium				O[1,2]	O[1,2]	O[1,2]	O[1,2]	O[1,2]	--[1]	[1]		X	X	X	X	X			X[3]	X[3]	X[3]	X[3]	X[3]	
Silver				X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	X[1,2]											X[3]	X[3]	X[3]	
Thallium									O					X							X	--	--	
Vanadium			O	O	O	O	--	O	O	--	X	X	--	--	X	X	--	X	X	--	X	X	X	--
Zinc	[1]		[1]	X[1,2]	--[1]	X[1,2]	X[1,2]	X[1,2]	X[1,2]	--[1]	--	--		X	X	X		X[3]	--		X[3]	X[3]	X[3]	--
Other																								
Cyanide	X			X	X	X	X	X	X	X	O	O	O	O	O	O	O		X		--			X

Notes

X = Chemical selected as a COPEC because screening-level HQ>1.
O = Chemical selected as a COPEC because no ecological screening value is available.
-- = Chemical selected as a COPEC based on screening-level evaluation, but removed based on COPEC refinement.
[1] Chemical is evaluated in food web modeling because it is bioaccumulative and detected in biota.
[2] Chemical is evaluated in food web modeling for semi-aquatic herbivorous receptors because it is bioaccumulative and selected as a refined COPEC in Surface Sediment.
[3] Chemical is evaluated in food web modeling for terrestrial herbivorous receptors because it is bioaccumulative and selected as a refined COPEC in Surface Soil for protection of birds and mammals.
Surface Sediment - Appendix G Tables G-23 through G-30 and for herbivorous semi-aquatic receptors Appendix G Tables G-31 through G-38
Surface Soil (Plants and Invertebrates) - Appendix G Tables G-39 through G-45
Surface Soil (Birds and Mammals) - Appendix G Tables G-46 through G-52

Table 5-9: Summary of Exposure Point Concentrations in Surface Water
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Exposure Point Concentration [1]	
		Value	Basis
Total PCB Aroclors	µg/L	0.11	95% Approximate Gamma UCL
TCDD TEQ (PCBs) (Bird)	µg/L	0.0000018	95% Student's-t UCL
TCDD TEQ (PCBs) (Mammal)	µg/L	0.00000020	95% Approximate Gamma UCL
Arsenic	µg/L	3.9	95% Student's-t UCL
Copper	µg/L	2.0	95% Modified-t UCL
Nickel	µg/L	3.7	95% Student's-t UCL
Zinc	µg/L	6.5	95% Student's-t UCL

Note:

[1] Exposure point concentration is the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), which was calculated using ProUCL version 4.1.00.

Table 5-10: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU GB
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	0.49 e	0.017 i	0.025 i	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	3.9 e	0.59 i	0.086 i	N/A	N/A	N/A	ND	9.3 b	N/A	N/A	1.4 i
Total DDx	mg/kg	ND	N/A	N/A	0.012 c	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	ND	N/A	N/A	0.0081 c	N/A	N/A	ND	N/A	ND	N/A	N/A
Total PCB Aroclors	mg/kg	0.090 a	0.011 i	0.000078 i	6.3 d	11 d	2.0 b	1.5 b	0.074 f	0.29 e	0.08 i	0.00045 i
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.000065 c	0.00037 c	0.000033 c	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00019 c	0.00058 c	0.00014 c	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	2.1 b	N/A	N/A	0.42 c	N/A	N/A	0.93 c	N/A	ND	N/A	N/A
Cadmium	mg/kg	0.81 c	N/A	N/A	0.36 c	N/A	N/A	0.78 f	1.1 b	ND	N/A	0.59 i
Chromium	mg/kg	20 b	N/A	N/A	0.62 f	N/A	N/A	0.89 c	41 b	ND	N/A	1.5 i
Copper	mg/kg	20 b	N/A	N/A	1.2 b	N/A	N/A	48 b	N/A	ND	N/A	N/A
Lead	mg/kg	47 d	N/A	N/A	0.67 b	N/A	N/A	0.84 f	N/A	ND	N/A	N/A
Mercury	mg/kg	0.18 c	0.00084 i	0.019 i	0.048 g	N/A	N/A	0.021 c	1.4 d	ND	N/A	0.42 i
Nickel	mg/kg	16 b	N/A	N/A	1.1 c	N/A	N/A	0.42 c	N/A	ND	N/A	N/A
Selenium	mg/kg	ND	N/A	N/A	1.0 b	N/A	N/A	0.92 e	N/A	ND	N/A	N/A
Silver	mg/kg	ND	N/A	N/A	0.22 c	N/A	N/A	1.1 g	N/A	ND	N/A	N/A
Zinc	mg/kg	73 b	N/A	N/A	22 b	N/A	N/A	30 a	166 d	ND	N/A	74 i

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = 95% Chebyshev (Mean, Sd) UCL
b = 95% Student's-t UCL
c = Maximum detected concentration.
d = 95% Approximate Gamma UCL
e = 95% Kaplan-Meier (t) UCL
f = 95% Kaplan-Meier (Percentile Bootstrap) UCL
g = 95% Kaplan-Meier (BCA) UCL
i = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in surface sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EUs BB3, BB2, BB1 and GB.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentration for PCBs in small mammals are on a wet weight basis and apply to EUs BB3, BB2, BB1, and GB.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-11: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB1
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	7.1 c	0.25 j	0.085 j	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	37 c	5.6 j	0.73 j	N/A	N/A	N/A	ND	8.7 f	N/A	N/A	1.3 j
Aldrin	mg/kg	0.00077 b	0.0000011 j	0.00000067 j	ND	N/A	N/A	ND	0.0014 b	ND	N/A	0.0000084 j
alpha-BHC	mg/kg	0.0046 b	0.047 j	0.00014 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
gamma-BHC	mg/kg	0.0025 b	0.025 j	0.000087 j	ND	N/A	N/A	ND	0.00024 b	ND	N/A	0.000059 j
Chlordane, Total	mg/kg	0.020 i	0.044 j	0.000025 j	ND	N/A	N/A	ND	0.23 b	ND	N/A	0.0020 j
Dieldrin	mg/kg	0.030 b	0.062 j	0.0016 j	ND	N/A	N/A	ND	0.030 b	ND	N/A	0.011 j
Total DDx	mg/kg	0.017 a	0.00011 j	0.00048 j	0.012 b	N/A	N/A	ND	0.11 b	ND	N/A	0.014 j
alpha-Endosulfan	mg/kg	0.0023 b	0.014 j	0.000069 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin	mg/kg	0.017 b	0.072 j	0.000083 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	0.0067 b	0.028 j	0.000056 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin ketone	mg/kg	0.020 b	0.084 j	0.00013 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor	mg/kg	0.0014 b	0.00000041 j	0.0000021 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	0.0069 b	0.00023 j	0.000045 j	0.0081 b	N/A	N/A	ND	N/A	ND	N/A	N/A
Methoxychlor	mg/kg	0.057 b	0.00057 j	0.00033 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Total PCB Aroclors	mg/kg	6.4 c	0.79 j	0.0055 j	6.3 f	11 f	2.0 h	1.5 h	0.86 c	0.29 h	0.91 j	0.0052 j
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.000065 b	0.00037 b	0.000033 b	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00019 b	0.00058 b	0.00014 b	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	8.2 c	0.0086 j	0.040 j	0.42 b	N/A	N/A	0.93 b	N/A	N/A	N/A	N/A
Cadmium	mg/kg	2.1 d	0.018 j	0.12 j	0.36 b	N/A	N/A	0.78 d	1.8 d	N/A	N/A	0.78 j
Chromium	mg/kg	43 e	0.025 j	0.23 j	0.62 d	N/A	N/A	0.89 b	N/A	N/A	N/A	N/A
Copper	mg/kg	112 f	1.6 j	1.6 j	1.2 h	N/A	N/A	48 h	N/A	N/A	N/A	N/A
Lead	mg/kg	148 f	0.17 j	0.57 j	0.67 h	N/A	N/A	0.84 d	96 f	N/A	N/A	3.1 j
Mercury	mg/kg	0.15 a	0.00069 j	0.017 j	0.048 i	N/A	N/A	0.021 b	0.19 a	N/A	N/A	0.14 j
Nickel	mg/kg	37 e	0.038 j	0.21 j	1.1 b	N/A	N/A	0.42 b	N/A	N/A	N/A	N/A
Selenium	mg/kg	1.1 b	0.0031 j	0.073 j	1.0 h	N/A	N/A	0.92 a	1.6 a	N/A	N/A	0.79 j
Silver	mg/kg	2.3 b	0.030 j	0.0042 j	0.22 b	N/A	N/A	1.1 i	N/A	N/A	N/A	N/A
Zinc	mg/kg	331 e	39 j	16 j	22 h	N/A	N/A	30 e	N/A	N/A	N/A	N/A

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = 95% Kaplan-Meier (t) UCL
b = Maximum detected concentration.
c = 95% or 99% Kaplan-Meier (Chebyshev) UCL
d = 95% Kaplan-Meier (Percentile Bootstrap) UCL
e = 95% Chebyshev (Mean, Sd) UCL
f = 95% Approximate Gamma UCL
g = 95% BCA Bootstrap
h = 95% Student's-t UCL
i = 95% Kaplan-Meier (BCA) UCL
j = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in surface sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EUs BB3, BB2, BB1 and GB.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentration for PCBs in small mammals are on a wet weight basis and apply to EUs BB3, BB2, BB1, and GB.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-12: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB2
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	1.8 b	0.064 h	0.046 h	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	25 f	3.7 h	0.50 h	N/A	N/A	N/A	ND	3.2 d	N/A	N/A	0.50 h
Aldrin	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
alpha-BHC	mg/kg	0.0059 a	0.060 h	0.00018 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-BHC	mg/kg	0.016 a	0.17 h	0.00052 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
gamma-BHC	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Chlordane, Total	mg/kg	0.0448 a	0.10 h	0.000056 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Dieldrin	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Total DDx	mg/kg	0.069 a	0.00044 h	0.0014 h	0.012 d	N/A	N/A	ND	N/A	ND	N/A	N/A
alpha-Endosulfan	mg/kg	0.0011 d	0.0065 h	0.000033 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-Endosulfan	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin	mg/kg	0.031 a	0.13 h	0.00015 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin ketone	mg/kg	0.0059 d	0.025 h	0.000038 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	ND	N/A	N/A	0.0081 d	N/A	N/A	ND	N/A	ND	N/A	N/A
Methoxychlor	mg/kg	0.12 d	0.0012 h	0.00069 h	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Total PCB Aroclors	mg/kg	3.5 b	0.44 h	0.0030 h	6.3 c	11 c	2.0 b	1.5 b	0.75 d	0.29 b	0.79 h	0.0045 h
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.000065 d	0.00037 d	0.000033 d	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00019 d	0.00058 d	0.00014 d	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	7.4 c	0.0077 h	0.036 h	0.42 d	N/A	N/A	0.93 d	N/A	N/A	N/A	N/A
Cadmium	mg/kg	30 c	0.25 h	0.51 h	0.36 d	N/A	N/A	0.78 f	N/A	N/A	N/A	N/A
Chromium	mg/kg	48 b	0.028 h	0.25 h	0.62 f	N/A	N/A	0.89 d	N/A	N/A	N/A	N/A
Copper	mg/kg	105 b	1.6 h	1.6 h	1.2 b	N/A	N/A	48 b	N/A	N/A	N/A	N/A
Lead	mg/kg	212 b	0.25 h	0.69 h	0.67 b	N/A	N/A	0.84 f	N/A	N/A	N/A	N/A
Mercury	mg/kg	0.51 b	0.0024 h	0.034 h	0.048 e	N/A	N/A	0.021 d	N/A	N/A	N/A	N/A
Nickel	mg/kg	33 c	0.034 h	0.19 h	1.1 d	N/A	N/A	0.42 d	N/A	N/A	N/A	N/A
Selenium	mg/kg	3.8 d	0.011 h	0.29 h	1.0 b	N/A	N/A	0.92 a	1.9 d	N/A	N/A	0.94 h
Silver	mg/kg	15 e	0.19 h	0.026 h	0.22 d	N/A	N/A	1.1 e	N/A	N/A	N/A	N/A
Zinc	mg/kg	369 b	N/A	N/A	22 b	N/A	N/A	30 g	N/A	N/A	N/A	N/A

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = 95% Kaplan-Meier (t) UCL
b = 95% Student's-t UCL
c = 95% Approximate Gamma UCL
d = Maximum detected concentration.
e = 95% Kaplan-Meier (BCA) UCL
f = 95% Kaplan-Meier (Percentile Bootstrap) UCL
g = 95% Chebyshev (Mean, Sd) UCL
h = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in surface sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EUs BB3, BB2, BB1 and GB.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentration for PCBs in small mammals are on a wet weight basis and apply to EUs BB3, BB2, BB1, and GB.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-13: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB3
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	8.7 c	0.30 j	0.093 j	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	33 e	4.9 j	0.65 j	N/A	N/A	N/A	ND	20 d	N/A	N/A	2.8 j
Aldrin	mg/kg	0.0015 b	0.0000021 j	0.0000013 j	ND	N/A	N/A	ND	0.0017 b	ND	N/A	0.000010 j
alpha-BHC	mg/kg	0.0057 a	0.059 j	0.00018 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-BHC	mg/kg	0.027 a	0.28 j	0.00087 j	ND	N/A	N/A	ND	0.0020 b	ND	N/A	0.00045 j
gamma-BHC	mg/kg	0.0051 a	0.052 j	0.00018 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Chlordane, Total	mg/kg	0.091 f	0.20 j	0.00011 j	ND	N/A	N/A	ND	0.035 b	ND	N/A	0.00031 j
Dieldrin	mg/kg	0.30 b	0.62 j	0.016 j	ND	N/A	N/A	ND	0.026 b	ND	N/A	0.0095 j
Total DDx	mg/kg	0.084 a	0.00053 j	0.0016 j	0.012 b	N/A	N/A	ND	0.056 a	ND	N/A	0.0084 j
alpha-Endosulfan	mg/kg	0.040 b	0.24 j	0.0012 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-Endosulfan	mg/kg	0.010 b	0.059 j	0.00030 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin	mg/kg	0.027 a	0.11 j	0.00013 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	0.018 b	0.076 j	0.00015 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin ketone	mg/kg	0.010 b	0.042 j	0.000064 j	ND	N/A	N/A	ND	0.0058 b	ND	N/A	0.00026 j
Heptachlor	mg/kg	0.0029 b	0.00000085 j	0.0000043 j	ND	N/A	N/A	ND	0.020 b	ND	N/A	0.00020 j
Heptachlor epoxide	mg/kg	0.0037 b	0.00012 j	0.000024 j	0.0081 b	N/A	N/A	ND	N/A	ND	N/A	N/A
Methoxychlor	mg/kg	0.028 b	0.00028 j	0.00016 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Total PCB Aroclors	mg/kg	6.5 c	0.81 j	0.0056 j	6.3 d	11 d	2.0 e	1.5 e	3.6 c	0.29 e	3.79 j	0.022 j
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.000065 b	0.00037 b	0.000033 b	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00019 b	0.00058 b	0.00014 b	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	6.4 d	0.0067 j	0.031 j	0.42 b	N/A	N/A	0.93 b	N/A	N/A	N/A	N/A
Cadmium	mg/kg	13 c	0.11 j	0.32 j	0.36 b	N/A	N/A	0.78 g	5.6 a	N/A	N/A	1.4 j
Chromium	mg/kg	40 d	0.024 j	0.22 j	0.62 g	N/A	N/A	0.89 b	70 d	N/A	N/A	2.6 j
Copper	mg/kg	90 d	1.5 j	1.5 j	1.2 e	N/A	N/A	48 e	2815 h	N/A	N/A	40 j
Lead	mg/kg	160 e	0.19 j	0.59 j	0.67 e	N/A	N/A	0.84 g	2042 d	N/A	N/A	17 j
Mercury	mg/kg	0.65 f	0.0030 j	0.039 j	0.048 f	N/A	N/A	0.021 b	2.1 d	N/A	N/A	0.52 j
Nickel	mg/kg	25 e	0.026 j	0.16 j	1.1 b	N/A	N/A	0.42 b	N/A	N/A	N/A	N/A
Selenium	mg/kg	1.4 e	0.0040 j	0.096 j	1.0 e	N/A	N/A	0.92 a	3.9 a	N/A	N/A	2.1 j
Silver	mg/kg	7.5 c	0.10 j	0.014 j	0.22 b	N/A	N/A	1.1 f	15 i	N/A	N/A	0.19 j
Zinc	mg/kg	287 d	34 j	14 j	22 e	N/A	N/A	30 h	1460 h	N/A	N/A	248 j

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = 95% Kaplan-Meier (t) UCL
b = Maximum detected concentration.
c = 95% Kaplan-Meier (Chebyshev) UCL
d = 95% Approximate Gamma UCL
e = 95% Student's-t UCL
f = 95% Kaplan-Meier (BCA) UCL
g = 95% Kaplan-Meier (Percentile Bootstrap) UCL
h = 95% Chebyshev (Mean, Sd) UCL
i= 97.5% Kaplan-Meier (Chebyshev) UCL
j = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in surface sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EUs BB3, BB2, BB1 and GB.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentration for PCBs in small mammals are on a wet weight basis and apply to EUs BB3, BB2, BB1, and GB.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-14: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB4
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	2.2 f	0.076 i	0.049 i	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	17 f	2.5 i	0.34 i	N/A	N/A	N/A	ND	13.9 c	N/A	N/A	2.0 i
Aldrin	mg/kg	0.0024 a	0.0000034 i	0.0000021 i	ND	N/A	N/A	ND	0.041 a	ND	N/A	0.00025 i
alpha-BHC	mg/kg	0.0068 b	0.069 i	0.00021 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-BHC	mg/kg	0.014 e	0.14 i	0.00045 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
gamma-BHC	mg/kg	0.0074 b	0.075 i	0.00026 i	ND	N/A	N/A	ND	0.013 a	ND	N/A	0.0032 i
Chlordane, Total	mg/kg	0.050 b	0.11 i	0.000062 i	ND	N/A	N/A	ND	0.148 b	ND	N/A	0.0013 i
Dieldrin	mg/kg	0.015 a	0.031 i	0.00080 i	ND	N/A	N/A	ND	0.35 b	0.013 e	N/A	0.13 i
Total DDx	mg/kg	0.068 b	0.00044 i	0.0014 i	0.021 a	N/A	N/A	ND	0.52 c	ND	N/A	0.045 i
alpha-Endosulfan	mg/kg	0.0073 a	0.043 i	0.00022 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-Endosulfan	mg/kg	0.025 a	0.15 i	0.00075 i	ND	N/A	N/A	ND	0.59 a	ND	N/A	0.12 i
Endosulfan sulfate	mg/kg	0.013 a	0.077 i	0.00049 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin	mg/kg	0.045 h	0.19 i	0.00022 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	0.019 e	0.080 i	0.00016 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin ketone	mg/kg	0.013 a	0.055 i	0.000084 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor	mg/kg	ND	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	0.034 a	0.0011	0.00022 i	0.013 a	N/A	N/A	ND	0.0062 a	0.069 a	N/A	N/A
Methoxychlor	mg/kg	0.032 a	0.00032 i	0.00018 i	ND	N/A	N/A	ND	0.043 a	ND	N/A	0.0017 i
Total PCB Aroclors	mg/kg	8.4 c	1.0 i	0.0072 i	13 f	10 f	2.0 f	1.5 f	13 c	0.97 f	13.86 i	0.080 i
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.000055 a	0.000065 a	0.000033 a	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00019 a	0.00018 a	0.00014 a	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	5.8 c	0.0060 i	0.028 i	ND	N/A	N/A	0.93 a	N/A	N/A	N/A	N/A
Cadmium	mg/kg	6.4 c	0.053 i	0.22 i	0.25 a	N/A	N/A	0.78 h	9.1 b	N/A	N/A	1.9 i
Chromium	mg/kg	32 g	0.019 i	0.17 i	0.23 a	N/A	N/A	0.89 a	98 c	N/A	N/A	3.7 i
Copper	mg/kg	66 g	1.3 i	1.3 i	0.91 f	N/A	N/A	48 f	134 c	N/A	N/A	12 i
Lead	mg/kg	101 d	0.12 i	0.46 i	0.64 f	N/A	N/A	0.84 h	242 d	N/A	N/A	5.2 i
Mercury	mg/kg	0.11 e	0.00050 i	0.015 i	0.046 f	N/A	N/A	0.021 a	0.45 c	N/A	N/A	0.22 i
Nickel	mg/kg	16 f	N/A	N/A	0.35 f	N/A	N/A	0.42 a	N/A	N/A	N/A	N/A
Selenium	mg/kg	3.3 a	0.0094 i	0.25 i	1.4 d	N/A	N/A	0.92 e	1.4 e	N/A	N/A	0.68 i
Silver	mg/kg	2.0 e	0.026 i	0.0037 i	0.21 f	N/A	N/A	1.1 b	8.1 h	N/A	N/A	0.10 i
Zinc	mg/kg	233 g	27 i	13 i	32 d	N/A	N/A	30 g	207 d	N/A	N/A	84 i

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = Maximum detected concentration.
b = 95% Kaplan-Meier (BCA) UCL
c = 95% or 97.5% Kaplan-Meier (Chebyshev) UCL
d = 95% Approximate Gamma UCL
e = 95% Kaplan-Meier (t) UCL
f = 95% Student's-t UCL
g = 95% Chebyshev (Mean, Sd) UCL
h = 95% Kaplan-Meier (Percentile Bootstrap) UCL
i = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in Surface Sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EU BB4.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentrations for small mammals are on a wet weight basis and apply to EU BB4.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-15: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB5
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
1,4-Dichlorobenzene	mg/kg	0.053 e	0.66 i	0.0027 i	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tetrachloroethene	mg/kg	0.037 e	1.5 i	0.0020 i	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dichlorobenzene	mg/kg	0.0077 e	0.025 i	0.00040 i	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
1,3-Dichlorobenzene	mg/kg	0.025 e	0.053 i	0.0011 i	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
LMW PAHs	mg/kg	1.2 d	0.043 i	0.038 i	N/A	N/A	N/A	ND	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	14 d	2.2 i	0.30 i	N/A	N/A	N/A	ND	29 d	N/A	N/A	4.0 i
Aldrin	mg/kg	ND	N/A	N/A	N/A	N/A	N/A	ND	0.00078 e	ND	N/A	0.0000047 i
alpha-BHC	mg/kg	0.017 b	0.17 i	0.00052 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-BHC	mg/kg	0.0067 e	0.07 i	0.00022 i	ND	N/A	N/A	ND	0.00031 e	ND	N/A	0.000070 i
gamma-BHC	mg/kg	0.043 e	0.44 i	0.0015 i	ND	N/A	N/A	ND	0.00040 e	ND	N/A	0.00010 i
Chlordane, Total	mg/kg	0.63 c	1.4 i	0.00079 i	ND	N/A	N/A	ND	0.12 b	ND	N/A	0.0010 i
Dieldrin	mg/kg	0.50 a	1.0 i	0.0266 i	ND	N/A	N/A	ND	10 c	0.037 b	N/A	3.73 i
Total DDx	mg/kg	0.73 a	0.0047 i	0.0083 i	0.022 e	N/A	N/A	ND	33 c	0.060 e	N/A	1.0 i
beta-Endosulfan	mg/kg	0.30 e	1.8 i	0.0090 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin	mg/kg	0.17 b	0.72 i	0.00083 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	0.071 b	0.30 i	0.00059 i	ND	N/A	N/A	ND	0.80 b	ND	N/A	0.046 i
Endrin ketone	mg/kg	0.020 e	0.084 i	0.00013 i	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor	mg/kg	0.0013 e	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	0.27 b	0.0089 i	0.0017 i	0.016 e	N/A	N/A	ND	1.8 b	ND	N/A	0.081 i
Methoxychlor	mg/kg	0.091 e	0.00091 i	0.00052 i	ND	N/A	N/A	ND	N/A	N/A	N/A	N/A
Total PCB Aroclors	mg/kg	29 c	3.6 i	0.025 i	14 d	37 f	2.0 f	1.5 f	33 c	4.2 f	35.14 i	0.20 i
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.00020 e	0.00060 e	0.000033 e	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.00055 e	0.0012 e	0.00014 e	N/A	N/A	N/A	N/A	N/A
Arsenic	mg/kg	8.4 c	0.0087 i	0.041 i	0.047 e	N/A	N/A	0.93 e	N/A	N/A	N/A	N/A
Cadmium	mg/kg	25 c	0.21 i	0.47 i	0.23 e	N/A	N/A	0.78 g	15 a	N/A	N/A	2.4 i
Chromium	mg/kg	30 d	0.018 i	0.16 i	0.17 e	N/A	N/A	0.89 e	45 d	N/A	N/A	1.7 i
Copper	mg/kg	72 d	1.4 i	1.4 i	1.7 f	N/A	N/A	48 f	230 d	N/A	N/A	15 i
Lead	mg/kg	188 d	0.22 i	0.65 i	0.52 f	N/A	N/A	0.84 g	387 d	N/A	N/A	6.8 i
Mercury	mg/kg	0.21 a	0.0010 i	0.021 i	0.18 c	N/A	N/A	0.021 e	0.61 a	N/A	N/A	0.26 i
Nickel	mg/kg	27 d	0.028 i	0.16 i	ND	N/A	N/A	0.42 e	N/A	N/A	N/A	N/A
Selenium	mg/kg	3.8 e	0.011 i	0.29 i	1.4 f	N/A	N/A	0.92 b	3.3 a	N/A	N/A	1.7 i
Silver	mg/kg	3.2 b	0.041 i	0.0057 i	0.19 b	N/A	N/A	1.1 a	6.4 b	N/A	N/A	0.081 i
Zinc	mg/kg	259 d	30 i	14 i	29 f	N/A	N/A	30 h	442 d	N/A	N/A	128 i

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = 95% Kaplan-Meier (BCA) UCL
b = 95% Kaplan-Meier (t) UCL
c = 95%, 97.5%, or 99% Kaplan-Meier (Chebyshev) UCL
d = 95% Approximate Gamma UCL
e = Maximum detected concentration.
f = 95% Student's-t UCL
g = 95% Kaplan-Meier (Percentile Bootstrap) UCL
h = 95% Chebyshev (Mean, Sd) UCL
i = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in Surface Sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EU BB5.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[6] Exposure point concentration for PCBs in small mammals are on a wet weight basis and apply to EUs BB5 and BB6.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-16: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU BB6
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment	Aquatic Plants (roots) [2]	Aquatic Plants (foliage) [2]	Predatory Fish [3]	Bottom-Feeding Fish [3]	Asiatic Clams [4]	Crayfish [5]	Surface Soil	Small Mammals [6]	Earthworms [7]	Terrestrial Plants (Seeds) [8]
LMW PAHs	mg/kg	0.30 h	0.010 j	0.020 j	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HMW PAHs	mg/kg	4.9 b	0.73 j	0.11 j	N/A	N/A	N/A	N/A	21 a	N/A	N/A	2.9 j
Aldrin	mg/kg	ND	N/A j	N/A j	ND	N/A	N/A	ND	0.0037 a	ND	N/A	0.000022 j
alpha-BHC	mg/kg	0.00087 a	0.0089 j	0.000027 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
beta-BHC	mg/kg	0.016 a	0.16 j	0.00052 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
delta-BHC	mg/kg	0.037 a	0.38 j	0.00074 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
gamma-BHC	mg/kg	ND	N/A j	N/A j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Chlordane, Total	mg/kg	0.040 i	0.087 j	0.000051 j	ND	N/A	N/A	ND	0.0080 a	ND	N/A	0.000070 j
Dieldrin	mg/kg	0.027 a	0.055 j	0.0014 j	ND	N/A	N/A	ND	0.061 a	0.037 b	N/A	0.023 j
Total DDx	mg/kg	0.0088 b	0.000056 j	0.00030 j	ND	N/A	N/A	ND	0.016 a	0.060 a	N/A	0.0033 j
beta-Endosulfan	mg/kg	0.0027 a	0.016 j	0.000081 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin aldehyde	mg/kg	ND	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Endrin ketone	mg/kg	ND	N/A	N/A	ND	N/A	N/A	ND	0.0040 a	ND	N/A	0.00018 j
Heptachlor	mg/kg	ND	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Heptachlor epoxide	mg/kg	N/A	N/A	N/A	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Methoxychlor	mg/kg	0.0091 a	0.000091 j	0.000052 j	ND	N/A	N/A	ND	N/A	ND	N/A	N/A
Total PCB Aroclors	mg/kg	0.46 a	0.057 j	0.00040 j	0.56 e	12 a	0.11 a	2.2 a	62 a	4.2 e	65 j	0.37 j
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A	N/A	N/A	0.0000089 a	0.0000078 a	0.0000031 a	N/A	N/A	N/A	N/A	N/A
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A	N/A	N/A	0.000031 a	0.000022 a	0.000011 a	N/A	N/A	N/A	N/A	N/A
Cadmium	mg/kg	19 c	0.16 j	0.40 j	ND	N/A	N/A	1.9 b	6.1 b	N/A	N/A	1.5 j
Chromium	mg/kg	30 d	0.018 j	0.16 j	ND	N/A	N/A	0.89 e	N/A	N/A	N/A	N/A
Copper	mg/kg	68 d	1.3 j	1.3 j	1.0 e	N/A	N/A	36 e	N/A	N/A	N/A	N/A
Lead	mg/kg	227 d	0.27 j	0.72 j	0.63 e	N/A	N/A	3.9 c	N/A	N/A	N/A	N/A
Mercury	mg/kg	0.19 b	0.00087 j	0.020 j	0.032 a	N/A	N/A	0.027 b	N/A	N/A	N/A	N/A
Nickel	mg/kg	39 d	0.040 j	0.22 j	ND	N/A	N/A	N/A	ND	N/A	N/A	N/A
Selenium	mg/kg	1.8 a	N/A	N/A	1.5 e	N/A	N/A	0.58 a	N/A	N/A	N/A	N/A
Silver	mg/kg	5.4 b	0.071 j	0.010 j	0.24 a	N/A	N/A	0.39 b	N/A	N/A	N/A	N/A
Zinc	mg/kg	258 d	30 j	14 j	21 e	N/A	N/A	24 e	N/A	N/A	N/A	N/A

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.* , the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = Maximum detected concentration.
b = 95% Kaplan-Meier (t) UCL
c = 95% Kaplan-Meier (Chebyshev) UCL
d = 95% Chebyshev (Mean, Sd) UCL
e = 95% Student's-t UCL
f = 95% Approximate Gamma UCL
g = 95% Adjusted Gamma UCL
h = 95% Kaplan-Meier (BCA) UCL
i = 95% Kaplan-Meier (Percentile Bootstrap) UCL
j = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in Surface Sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EU BB6.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EU BB6.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EU BB6.

[6] Exposure point concentrations for small mammals are on a wet weight basis and apply to EUs BB5 and BB6.

[7] Exposure point concentration for PCBs in earthworms are on a wet weight basis and are estimated based on EPCs for Surface Soil and a site-specific bioacumulation factor of 1.05 as presented in Table 5-22.

[8] Exposure point concentrations for terrestrial plants presented on a wet weight basis and are estimated based on EPCs in Surface Soil and dry weight soil-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 9.3% for seeds.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-17: Summary of Exposure Point Concentrations [1] for Food Web Modeling - EU SL
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Units	Surface Sediment		Aquatic Plants (roots) [2]		Aquatic Plants (foliage) [2]		Predatory Fish [3]		Bottom-Feeding Fish [3]		Asiatic Clams [4]		Crayfish [5]	
LMW PAHs	mg/kg	4.1	a	0.14	h	0.066	h	N/A		N/A		N/A		N/A	
HMW PAHs	mg/kg	51	a	7.6	h	0.98	h	N/A		N/A		N/A		N/A	
Chlordane, Total	mg/kg	0.12	e	0.26	h	0.00015	h	N/A		N/A		N/A		ND	
Total DDx	mg/kg	0.30	a	0.0019	h	0.0043	h	N/A		N/A		N/A		ND	
Endrin aldehyde	mg/kg	ND		N/A		N/A		N/A		N/A		N/A		ND	
Heptachlor epoxide	mg/kg	0.023	a	N/A		N/A		N/A		N/A		N/A		ND	
Total PCB Aroclors	mg/kg	0.057	a	N/A		N/A	h	1.3	b	13	c	2.0	b	1.5	b
TCDD TEQ (PCBs) (Mammal)	mg/kg	N/A		N/A		N/A		0.000018	a	0.000043	a	0.000033	a	N/A	
TCDD TEQ (PCBs) (Bird)	mg/kg	N/A		N/A		N/A		0.000060	a	0.00016	a	0.00014	a	N/A	
Arsenic	mg/kg	3.3	a	N/A		N/A		ND		N/A		N/A		0.93	a
Cadmium	mg/kg	2.5	a	N/A		N/A		ND		N/A		N/A		0.78	d
Chromium	mg/kg	41	a	N/A		N/A		ND		N/A		N/A		0.89	a
Copper	mg/kg	81	a	N/A		N/A		ND		N/A		N/A		48	b
Lead	mg/kg	290	a	0.34	h	0.83	h	ND		N/A		N/A		0.84	d
Mercury	mg/kg	0.43	a	0.0020	h	0.031	h	ND		N/A		N/A		0.021	a
Nickel	mg/kg	25	a	N/A		N/A		ND		N/A		N/A		0.42	a
Selenium	mg/kg	ND		N/A		N/A		ND		N/A		N/A		0.92	e
Silver	mg/kg	1.1	a	0.014	h	0.0020	h	ND		N/A		N/A		1.1	f
Zinc	mg/kg	300	a	N/A		N/A		ND		N/A		N/A		30	g

Notes:

[1] Exposure point concentration is either the 95% Upper Confidence Level (UCL) on the arithmetic average concentration (*i.e.*, the 95% UCL concentration), the maximum detected concentration, or an estimated concentration. 95% UCL concentrations were calculated using ProUCL version 4.1.00 for data sets with fewer than 70% non-detects and more than four samples. The following are codes for the basis of each EPC:

a = Maximum detected concentration.
b = 95% Student's-t UCL
c = 95% Approximate Gamma UCL
d = 95% Kaplan-Meier (Percentile Bootstrap) UCL
e = 95% Kaplan-Meier (t) UCL
f = 95% Kaplan-Meier (BCA) UCL
g = 95% Chebyshev (Mean, Sd) UCL
h = estimated

[2] Exposure point concentrations for aquatic plants presented on a wet weight basis and are estimated based on EPCs in Surface Sediment and dry weight sediment-to-plant BAFs shown in Table 5-23. Estimated dry weight concentrations were converted to wet weight using a moisture content of 87% for root vegetables and 87% for foliage.

[3] Exposure point concentrations for whole body predatory and bottom-feeding fish are on a wet weight basis and apply to EU SL.

[4] Exposure point concentrations for Asiatic clams are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

[5] Exposure point concentrations for crayfish are on a wet weight basis and apply to EUs BB5, BB4, BB3, BB2, BB1, GB, and SL.

ND = Not Detected
N/A = Not Applicable or Not Analyzed

Table 5-18: Summary of Whole Body Fish Tissue Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	Predatory Fish All EUs		Bottom-Feeding Fish All EUs	
	Detection Frequency	Range of Detected Concentrations mg/kg, wet weight	Detection Frequency	Range of Detected Concentrations mg/kg, wet weight
Polychlorinated Biphenyls				
Total PCB Aroclors [1]	80 / 80	0.21 - 20	59 / 59	0.21 - 48.97
2,3,7,8-TCDD-Like Congeners TEQ				
TCDD TEQ (PCBs) (Mammal) [2]	8 / 8	8.9E-06 - 2.0E-04	10 / 10	7.8E-06 - 6.0E-04
TCDD TEQ (PCBs) (Bird) [3]	8 / 8	3.1E-05 - 5.5E-04	10 / 10	2.2E-05 - 1.2E-03
TCDD TEQ (PCBs) (Fish) [3]	8 / 8	4.2E-07 - 8.0E-06	10 / 10	3.7E-07 - 2.8E-05
Pesticides				
Total DDx	11 / 46	0.003 - 0.022	N/A	N/A
Heptachlor Epoxide	11 / 46	0.001 - 0.016	N/A	N/A
Metals				
Arsenic	6 / 46	0.15 - 0.42	N/A	N/A
Cadmium	7 / 46	0.14 - 0.36	N/A	N/A
Chromium	26 / 46	0.07 - 2.1	N/A	N/A
Copper	46 / 46	0.58 - 2.8	N/A	N/A
Lead	46 / 46	0.15 - 2.9	N/A	N/A
Mercury	43 / 46	0.019 - 0.19	N/A	N/A
Nickel	9 / 46	0.13 - 1.1	N/A	N/A
Selenium	46 / 46	0.56 - 1.6	N/A	N/A
Silver	19 / 46	0.081 - 0.24	N/A	N/A
Zinc	46 / 46	15 - 37	N/A	N/A

Notes:
Summary of detected COPEC concentrations in whole body fish tissue.
[1] Total PCB Aroclors is the sum of detected Aroclor 1254 and Aroclor 1260 concentrations.
[2] TCDD TEQ (PCBs) - mammal was calculated for detected PCB congeners using the toxic equivalency factors for fish from the World Health Organization (2005).
[3] TCDD TEQ (PCBs) - bird and TCDD TEQ (PCBs) - fish were calculated for detected PCB congeners using the toxic equivalency factors for birds and fish, respectively, from Van den Berg et al. (1998).

Table 5-19: Summary of Crayfish Tissue Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	All EUs	
	Detection Frequency	Range of Detected Concentrations mg/kg, wet weight
Polychlorinated Biphenyls		
Total PCB Aroclors [1]	29 / 38	0.4 - 2.4
Metals		
Arsenic	2 / 38	0.39 - 0.93
Cadmium	26 / 38	0.23 - 5.4
Chromium	1 / 38	-- - 0.89
Copper	38 / 38	3.9 - 70
Lead	32 / 38	0.27 - 6.5
Mercury	10 / 38	0.015 - 0.036
Nickel	4 / 38	0.23 - 0.42
Silver	32 / 38	0.19 - 2.5
Zinc	38 / 38	2.2 39

Notes:

Summary of detected COPEC concentrations in crayfish tissue.

[1] Total PCB Aroclors is the sum of detected Aroclor 1254 and Aroclor 1260 concentrations.

Table 5-20: Summary of Asiatic Clam Tissue Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	All EUs	
	Detection Frequency	Range of Detected Concentrations mg/kg, wet weight
Polychlorinated Biphenyls		
Total PCB Aroclors [1]	14 / 15	0.062 - 2.76
2,3,7,8-TCDD-Like Congeners TEQ		
TCDD TEQ (PCBs) (Mammal) [2]	5 / 5	3.1E-06 - 3.3E-05
TCDD TEQ (PCBs) (Bird) [3]	5 / 5	1.1E-05 - 1.4E-04
TCDD TEQ (PCBs) (Fish) [3]	5 / 5	9.6E-07 - 2.9E-06

Notes:
Summary of detected COPEC concentrations in Asiatic clam tissue.
[1] Total PCB Aroclors is the sum of detected Aroclor 1254 and Aroclor 1260 concentrations.
[2] TCDD TEQ (PCBs) - mammal was calculated for detected PCB congeners using the toxic equivalency factors for fish from the World Health Organization (2005).
[3] TCDD TEQ (PCBs) - bird and TCDD TEQ (PCBs) - fish were calculated for detected PCB congeners using the toxic equivalency factors for birds and fish, respectively, from Van den Berg et al. (1998).

Table 5-21: Summary of Mouse Tissue Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Chemical of Potential Ecological Concern	All EUs	
	Detection Frequency	Range of Detected Concentrations mg/kg, wet weight
Polychlorinated Biphenyls		
Total PCB Aroclors [1]	28 / 32	0.15 - 5.4
Pesticides		
Total DDx	1 / 32	0.06 - 0.06
Dieldrin	12 / 32	0.01 0.06
Heptachlor epoxide	2 / 32	0.02 - 0.07

Notes:

Summary of detected COPEC concentrations in mouse tissue.

[1] Total PCB Aroclors is the sum of detected Aroclor 1254 and Aroclor 1260 concentrations.

Table 5-22: Summary of Soil-to-Earthworm Bioaccumulation Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

OU4 Study Area Location:		BB-SL01			BB-SL02			BB-SL03		
Compound	Units	Soil Concentration	Tissue Concentration	BAF (Tissue/Soil)	Soil Concentration	Tissue Concentration	BAF (Tissue/Soil)	Soil Concentration	Tissue Concentration	BAF (Tissue/Soil)
Total PCB Congeners	pg/g	60,222,215	75,034,865	1.25	13,200,308	12,294,271	0.93	3,617,976	3,472,527	0.96

Reference Location:		AB-SL01		
Compound	Units	Soil Concentration	Tissue Concentration	BAF (Tissue/Soil)
Total PCB Congeners	pg/g	682,758	383,749	0.56

Site-Specific Average Soil-to-Earthworm BAF	1.05

Notes
BB-SL01 - Near RM5.8 (south bank) in EU BB4
BB-SL02 - Near RM5.7 (north bank) in EU BB4
BB-SL03 - Near RM3.15 (south bank) in EU BB1
AB-SL01 - Ambrose Brook Floodplain Soil Sample Location
BAF = soil-to-earthworm bioaccumulation factor

Table 5-23: Sediment-to-Plant and Soil-to-Plant Bioaccumulation Factors (BAFs) for COPECs
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC [1]	Sediment-to-Plant (root) BAFs ($Br_{rootveg}$) [2] unitless - dry weight		Sediment- and Soil-to-Plant (aboveground) BAFs (Br_{ag}) [3] unitless - dry weight	
Volatile Organic Compounds				
1,4-Dichlorobenzene	95.9	a	$C_p = C_S * 0.39$	c
Tetrachloroethene	311.0	a	$C_p = C_S * 0.411$	c
Semi-Volatile Organic Compounds				
1,2-Dichlorobenzene	24.5	a	$C_p = C_S * 0.395$	c
1,3-Dichlorobenzene	16.2	a	$C_p = C_S * 0.346$	c
LMW PAHs [4]	0.269	a	$\ln(C_p) = 0.4544 * \ln(C_s) - 1.3205$	b
HMW PAHs [4]	1.15	a	$\ln(C_p) = 0.9469 * \ln(C_s) - 1.7026$	b
Polychlorinated Biphenyls				
Total PCB Aroclors	0.958	a	$C_p = C_S * 0.00665$	c
Pesticides				
Aldrin	0.0108	a	$C_p = C_S * 0.00665$	c
alpha-BHC	78.4	a	$C_p = C_S * 0.241$	c
beta-BHC	78.4	a	$C_p = C_S * 0.248$	c
delta-BHC [5]	78.4	a	$C_p = C_S * 0.153$	c
gamma-BHC [5]	78.4	a	$C_p = C_S * 0.269$	c
Chlordane, Total	16.6	a	$C_p = C_S * 0.00965$	c
Dieldrin	15.8	a	$C_p = C_S * 0.41$	b
Total DDx [6]	0.0492	a	$\ln(C_p) = 0.7524 * \ln(C_s) - 2.5119$	b
alpha-Endosulfan [7]	45.6	a	$C_p = C_S * 0.232$	c
beta-Endosulfan [7]	45.6	a	$C_p = C_S * 0.232$	c
Endosulfan sulfate [7]	45.6	a	$C_p = C_S * 0.291$	c
Endrin	32.4	a	$C_p = C_S * 0.0375$	c
Endrin aldehyde	32.4	a	$C_p = C_S * 0.0639$	c
Endrin ketone	32.4	a	$C_p = C_S * 0.0496$	c
Heptachlor	0.00226	a	$C_p = C_S * 0.0113$	c
Heptachlor epoxide	0.257	a	$C_p = C_S * 0.0502$	c
Methoxyclor	0.0769	a	$C_p = C_S * 0.044$	c
Metals				
Arsenic	0.008	a	$C_p = C_s * 0.03752$	b
Cadmium	0.064	a	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	b
Chromium	0.0045	a	$C_p = 0.041*C_s$	b
Copper [8]	NA		$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	b
Lead	0.009	a	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	b
Mercury	0.036	a	$\ln(C_p) = 0.544 * \ln(C_s) - 0.966$	d
Nickel	0.008	a	$\ln(C_p) = 0.748 * \ln(C_s) - 2.223$	b
Selenium	0.022	a	$\ln(C_p) = 1.104 * \ln(C_s) - 0.677$	b
Silver	0.1	a	$C_p = C_s * 0.014$	b
Zinc	0.9	a	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	b

Notes:

[1] Plant concentrations estimated for refined bioaccumulative COPECs in Surface Sediment and Surface Soil as shown in Table 5-8.

[2] $Br_{rootveg}$ are used to estimate COPEC concentration in roots of aquatic vegetation.

[3] Br_{ag} are used to estimate COPEC concentration in foliage of aquatic vegetation and seeds of terrestrial vegetation. Log Kow values for deriving Br_{ag} using Travis and Arms (1988) equation [i.e., $\log(C_P) = 1.58 - 0.58 *$ log Kow] were obtained from the Risk Assessment Information System, accessed online at: http://rais.ornl.gov/.

[4] The highest $Br_{rootveg}$ for individual LMW PAHs (naphthalene) and individual HMW PAHs (benzo[b]fluoranthene) was selected to represent total LMW PAHs and total HMW PAHs, respectively.

[5] $Br_{rootveg}$ for alpha-BHC and beta-BHC used for delta-BHC and gamma-BHC.

[6] $Br_{rootveg}$ for 4,4'DDT used for total DDx.

[7] $Br_{rootveg}$ for endosulfan used for alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

[8] Since $Br_{rootveg}$ is not available for copper, the Br_{ag} is used to estimate COPEC concentrations in roots of aquatic vegetation.

NA = Not Available
ln = natural logarithm
log = base 10 logarithm
C_p = Concentration in plant tissue
C_s = Concentration in Surface Soil
a = USEPA, 2005e.
b = USEPA, 2007h.
c = Travis and Arms, 1988.
d = Bechtel-Jacobs, 1998.

Table 5-24: Critical Body Residues - Whole Body Invertebrate Tissue
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

CAS Number	COPEC	NOAEL[3] mg/kg	LOAEL[3] mg/kg	Species	Effect Class	Toxicity Measure
Metals						
7440-38-2	Arsenic	0.0249	0.249	Mayfly	Growth	ED43
7440-43-9	Cadmium	0.0708	0.708	Cladoceran	Mortality	LOED
7440-47-3	Chromium	0.144	1.44	Stonefly	Mortality	ED10
7440-50-8	Copper	80	800	Zebra mussel	Mortality	NOED
7439-92-1	Lead	0.522	5.22	Amphipod	Mortality	LD25
7439-97-6	Mercury	0.00246	0.0246	Mayfly	Growth	ED168
7440-02-0	Nickel	0.11	1.1	Amphipod	Mortality	LD25
7782-49-2	Selenium	0.02	0.2	Midge	Growth	ED40
7440-22-4	Silver	0.0175	0.175	Water flea	Mortality	LD50
7440-66-6	Zinc	1.112	11.12	Water flea	Reproduction	ED60, LOED
Pesticides						
72-54-8	4,4'-DDD	--	--	--	--	--
72-55-9	4,4'-DDE	--	--	--	--	--
50-29-3	4,4'-DDT	6	60	Mayfly	Growth/Mortality	NOED
1024-57-3	Heptachlor epoxide	0.26	2.6	Grass shrimp	Mortality	NOED
Polychlorinated Biphenyls						
	Total PCB Aroclors[1]	0.1	1.1	Grass shrimp	Mortality	LOED
	TCDD TEQ (PCBs)[2]	0.0003	0.003	Crayfish	Mortality	LD25

Notes:

[1] Critical body residues for PCBs were used to evaluate total PCB Aroclors (*i.e.* , the sum of detected Aroclor 1248, Aroclor 1254, and Aroclor 1260) tissue concentrations.

[2] Critical body residues for 2,3,7,8-TCDD were used to evaluate TCDD TEQ (PCBs) tissue concentrations.

[3] NOAEL and LOAEL critical body residues were derived from data retrieved from the U.S. Army Corps of Engineers (USACE)/USEPA Environmental Residue-Effects Database (ERED) (http://el.erdc.usace.army.mil/ered/), as presented in Appendix I.

-- = No whole body tissue data available for selected species and effects classes.

Table 5-25: Critical Body Residues - Whole Body Fish Tissue
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

CAS Number	COPEC	NOAEL[3] mg/kg	LOAEL[3] mg/kg	Species	Effect Class	Toxicity Measure
Metals						
7440-38-2	Arsenic	0.04	0.40	Rainbow trout	Mortality	LD50
7440-43-9	Cadmium	0.0032	0.032	Bull trout	Growth	LOED
7440-47-3	Chromium	--	--	--	--	--
7440-50-8	Copper	0.196	1.96	Rainbow trout	Growth	LOED
7439-92-1	Lead	0.0278	0.278	Rainbow trout	Growth	ED11, ED16, ED19, ED30
7439-97-6	Mercury	0.006	0.06	Channel catfish	Mortality	LD50
7440-02-0	Nickel	--	--	--	--	--
7782-49-2	Selenium	0.018	0.18	Fathead minnow	Growth	LOED
7440-22-4	Silver	0.0114	0.114	Fathead minnow	Growth	ED33
7440-66-6	Zinc	0.45	4.5	Brook trout	Mortality	LOED
Pesticides						
72-54-8	4,4'-DDD	0.06	0.6	Fathead minnow	Reproduction	LOED
72-55-9	4,4'-DDE	0.029	0.29	Lake trout	Mortality	LOED
50-29-3	4,4'-DDT	0.029	0.29	Lake trout	Mortality	LOED
1024-57-3	Heptachlor epoxide	--	--	--	--	--
Polychlorinated Biphenyls						
	Total PCB Aroclors[1]	0.014	0.14	Zebra danio	Growth	LOED
	TCDD TEQ (PCBs)[2]	0.000003	0.00003	Rainbow trout	Growth	ED13, ED27

Notes:

[1] Critical body residues for PCBs were used to evaluate total PCB Aroclors (*i.e.* , the sum of detected Aroclor 1248, Aroclor 1254, and Aroclor 1260) tissue concentrations.

[2] Critical body residues for 2,3,7,8-TCDD were used to evaluate TCDD TEQ (PCBs) tissue concentrations.

[3] NOAEL and LOAEL critical body residues were derived from data retrieved from the U.S. Army Corps of Engineers (USACE)/USEPA Environmental Residue-Effects Database (ERED) (http://el.erdc.usace.army.mil/ered/), as presented in Appendix I.

-- = No whole body tissue data available for selected species and effects classes.

Table 5-26: Critical Egg Residues - Fish
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

CAS Number	COPEC	NOAEL mg/kg	LOAEL mg/kg	Species	Effect Class	Toxicity Measure
Polychlorinated Biphenyls						
	TCDD TEQ (PCBs)[1]	0.00000722	0.0000861	various	various	95% Lower and Upper Confidence Limits

Notes:

[1] Critical egg residues for 2,3,7,8-TCDD are based on thresholds derived by Steevens et al., 2005 and converted from ng TCDD/g lipid to mg/kg using average lake trout egg lipid contact (8.2%) from Cooke et al., 2003.

Table 5-27: Critical Egg Residues - Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

CAS Number	COPEC	NOAEL[3] mg/kg	LOAEL[3] mg/kg	Species	Effect Class	Toxicity Measure
Pesticides						
72-54-8	4,4'-DDD	0.18	1.8	Osprey	Reproduction	NOED
72-55-9	4,4'-DDE	0.00042	0.0042	Osprey	Reproduction	ED15
50-29-3	4,4'-DDT	0.46	5	Snowy egret	Physiological	NOED
1024-57-3	Heptachlor epoxide	--	--	--	--	--
Polychlorinated Biphenyls						
	Total PCB Aroclors[1]	1.1	10.9	Black-crowned night heron	Reproduction	ED
	TCDD TEQ (PCBs)[2]	0.000002	0.00002	Wood duck	Reproduction	LOED

Notes:

[1] Critical egg residues for PCBs were used to evaluate estimated total PCB Aroclors (*i.e.* , the sum of detected Aroclor 1248, Aroclor 1254, and Aroclor 1260) egg concentrations.

[2] Critical egg residues for 2,3,7,8-TCDD were used to evaluate TCDD TEQ (PCBs).

[3] NOAEL and LOAEL critical body residues were derived from data retrieved from the U.S. Army Corps of Engineers (USACE)/USEPA Environmental Residue-Effects Database (ERED) (http://el.erdc.usace.army.mil/ered/), as presented in Appendix I.

-- = No egg residue data available for selected species.

Table 5-28: Exposure Parameters for Wildlife Receptor Species
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Representative Wildlife Species	Body Weight kg	Food Ingestion Rate kg/day, dw	Food Ingestion Rate[1] kg/day, ww	Water Ingestion Rate L/day	Proportion of Diet: Plants %	Invertebrates %	Fish %	Small Mammals %	Proportion Sediment/Soil in Diet (%)	Sediment/Soil Ingestion Rate kg/day, dw	Home Range ha
Semi-Aquatic Receptors											
Wood duck	0.66	0.054	0.42	0.045	100	--	--	--	2	0.001	15
Mallard	1.1	0.079	0.34	0.064	--	100	--	--	3.3	0.003	303
Red-winged blackbird	0.053	0.01	0.042	0.0083	--	100	--	--	1	0.0001	0.17
Great blue heron	2.3	0.13	0.46	0.10	--	2	98	--	1	0.001	4.5
Belted kingfisher	0.15	0.02	0.075	0.017	--	30	70	--	2	0.0004	1.2
Muskrat	1.2	0.062	0.48	0.11	100	--	--	--	9.4	0.0058	0.17
Raccoon	5.3	0.19	0.81	0.44	--	95	5	--	9.4	0.02	21
Little brown bat	0.008	0.002	0.007	0.001	--	100	--	--	--	--	10
American mink	1.0	0.056	0.21	0.1	--	12	88	--	2	0.001	14
Terrestrial Receptors											
Mourning dove	0.127	0.018	0.02	0.015	100	--	--	--	2	0.0004	2,500
American robin	0.081	0.023	0.098	0.011	--	100	--	--	10.4	0.002	0.24
Red-tailed hawk	1.1	0.035	0.11	0.063	--	--	--	100	1	0.0004	624
Eastern gray squirrel	0.533	0.035	0.04	0.056	100	--	--	--	2	0.0007	1.8
Short-tailed shrew	0.0157	0.003	0.011	0.0035	--	100	--	--	13	0.0003	0.11
Red fox	4.9	0.18	0.58	0.42	--	8	--	92	2.8	0.005	737

Notes:

[1] Food ingestion rates on a dry weight basis are converted to a wet weight basis assuming average moisture contents of 87% for aquatic roots and foliage, 9.3 percent for seeds, 77 percent for invertebrates, 72 percent for fish, and 68 percent for small mammals (USEPA, 1993 and USEPA, 2005e).

Table 5-29: Area Use Factor Calculations
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Representative Wildlife Species	Home Range ha	Area Use Factors (unitless)							
		GB	BB1	BB2	BB3	BB4	BB5	BB6	SL
	EU Area (ha):	51	147	30	68	83	47	65	61
Semi-Aquatic Receptors									
Wood duck	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mallard	303	0.2	0.5	0.1	0.2	0.3	0.2	0.2	0.2
Red-winged blackbird	0.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Great blue heron	4.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Belted kingfisher	1.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Muskrat	0.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Raccoon	21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Little brown bat	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
American mink	14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Terrestrial Receptors									
Mourning dove	2,500	0.02	0.06	0.01	0.03	0.03	0.02	0.03	0.02
American robin	0.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Red-tailed hawk	624	0.08	0.2	0.05	0.11	0.1	0.1	0.1	0.1
Eastern gray squirrel	1.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Short-tailed shrew	0.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Red fox	737	0.07	0.2	0.04	0.09	0.1	0.06	0.09	0.08

Notes:
ha = hectares

Table 5-30: Summary of Wildlife Toxicity Reference Values - Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	Toxicity Reference Values (TRV) NOAEL-Based mg/kg/d	Toxicity Reference Values (TRV) LOAEL-Based mg/kg/d	Test Species	Effect	Reference
Volatile Organic Compounds					
1,4-Dichlorobenzene	NA	NA	--	--	--
Tetrachloroethene	NA	NA	--	--	--
Semi-Volatile Organic Compounds					
1,2-Dichlorobenzene	NA	NA	--	--	--
1,3-Dichlorobenzene	NA	NA	--	--	--
Low Molecular Weight PAHs	1,653	16,530	Bobwhite quail	Growth, Mortality	Landis Assoc.Inc, 1985 as cited in USEPA, 2007e
High Molecular Weight PAHs	2	20	European starling	Growth	Trust et al., 1994 as cited in USEPA, 2007e
Polychlorinated Biphenyls					
Total PCBs	0.11	1.1	Ring dove	Reproduction	Peakall and Peakall, 1973
TCDD TEQ					
TCDD TEQ (PCBs)	0.000014	0.00014	Ring-necked pheasant	Reproduction	Sample et al., 1996
Pesticides					
Aldrin	0.027	0.27	Japanese quail	Mortality	Hall et al. 1975
alpha-BHC[1]	0.56	2.25	Japanese quail	Reproduction	Sample et al., 1996
beta-BHC[1]	0.56	2.25	Japanese quail	Reproduction	Sample et al., 1996
delta-BHC[1]	0.56	2.25	Japanese quail	Reproduction	Sample et al., 1996
gamma-BHC[1]	0.56	2.25	Japanese quail	Reproduction	Sample et al., 1996
Chlordane	2.14	10.7	Redwinged blackbird	Mortality	Sample et al., 1996
Dieldrin	0.0709	1.1	Mallard	Growth, Mortality	USEPA 2007c
Total DDx	0.227	4.2	Chicken	Growth	USEPA, 2007b
alpha-Endosulfan[2]	10	100	Gray partridge	Reproduction	Sample et al., 1996
beta-Endosulfan[2]	10	100	Gray partridge	Reproduction	Sample et al., 1996
Endosulfan sulfate[2]	10	100	Gray partridge	Reproduction	Sample et al., 1996
Endrin	0.01	0.1	Screech owl	Reproduction	Sample et al., 1996
Endrin aldehyde[3]	0.01	0.1	Screech owl	Reproduction	Sample et al., 1996
Endrin ketone[3]	0.01	0.1	Screech owl	Reproduction	Sample et al., 1996
Heptachlor	0.65	6.5	Quail	Mortality	USEPA, 1999c
Heptachlor epoxide[4]	0.65	6.5	Quail	Mortality	USEPA, 1999c
Methoxychlor	3.2	32	Mallard	Mortality	USEPA, 2000b
Metals					
Arsenic	2.24	4.5	multiple	Reproduction, Growth	USEPA, 2005a
Cadmium	1.47	7.7	multiple	Reproduction, Growth	USEPA, 2005b
Chromium	2.66	11	multiple	Reproduction, Growth	USEPA, 2008a
Copper	4.05	37	Chicken	Reproduction	USEPA, 2007a
Lead	1.63	52	Chicken	Reproduction	USEPA, 2005c
Mercury[5]	0.45	0.9	Japanese quail	Reproduction	Sample et al., 1996
Nickel	6.71	22	multiple	Reproduction, Growth	USEPA, 2007d
Selenium	0.29	1.2	Chicken	Mortality	USEPA, 2007f
Silver	2.02	20.2	Turkey	Growth	USEPA, 2006
Zinc	66.1	189	multiple	Reproduction, Growth	USEPA, 2007g

Notes

[1] BHC mixed isomers TRVs used for all isomers.

[2] Endosulfan TRVs used for alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

[3] Endrin TRVs used for endrin aldehyde and endrin ketone.

[4] Heptaclor TRVs used for heptachlor epoxide.

[5] Mercuric chloride TRVs used for mercury.

Table 5-31: Summary of Wildlife Toxicity Reference Values - Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	Toxicity Reference Values (TRV)		Test Species	Effect	Reference
	NOAEL-Based mg/kg/d	LOAEL-Based mg/kg/d			
Volatile Organic Compounds					
1,4-Dichlorobenzene	NA	NA	--	--	--
Tetrachloroethene	NA	NA	--	--	--
Semi-Volatile Organic Compounds					
1,2-Dichlorobenzene	NA	NA	--	--	--
1,3-Dichlorobenzene	NA	NA	--	--	--
Low Molecular Weight PAHs	65.6	328	Rat	Growth	USEPA, 2007e
High Molecular Weight PAHs	0.615	3.07	Mouse	Mortality	USEPA, 2007e
Polychlorinated Biphenyls					
Total PCBs (non-piscivorous mammals)[1]	0.305	3.05	--	--	USEPA , 2004 and Spencer, 1982
Total PCBs (piscivorous mammals)[1]	0.11	0.23	Mink	Reproduction	Halbrook et al., 1999
TCDD TEQ					
TCDD TEQ (PCBs)	0.000001	0.00001	Rat	--	Sample et al., 1996
Pesticides					
Aldrin	0.2	1	Rat	Reproduction	Sample et al., 1996
alpha-BHC[2]	1.6	3.2	Rat	Reproduction	Sample et al., 1996
beta-BHC[2]	1.6	3.2	Rat	Reproduction	Sample et al., 1996
delta-BHC[2]	1.6	3.2	Rat	Reproduction	Sample et al., 1996
gamma-BHC[2]	1.6	3.2	Rat	Reproduction	Sample et al., 1996
Chlordane	4.58	9.16	Mouse	Reproduction	Sample et al., 1996
Dieldrin	0.015	1.6	Multiple	Reproduction	USEPA 2007c
Total DDx	0.147	8	Multiple	Reproduction	USEPA, 2007b
alpha-Endosulfan[3]	0.15	1.5	Rat	Reproduction	Sample et al., 1996
beta-Endosulfan[3]	0.15	1.5	Rat	Reproduction	Sample et al., 1996
Endosulfan sulfate[3]	0.15	1.5	Rat	Reproduction	Sample et al., 1996
Endrin	0.092	0.92	Multiple	Reproduction	Sample et al., 1996
Endrin aldehyde[4]	0.092	0.92	Multiple	Reproduction	Sample et al., 1996
Endrin ketone[4]	0.092	0.92	Multiple	Reproduction	Sample et al., 1996
Heptachlor	0.13	6.8	Multiple	--	Engineering Field Activity West, 1997
Heptachlor epoxide[5]	0.13	6.8	Multiple	--	Engineering Field Activity West, 1997
Methoxychlor	2.5	50	Multiple	--	Engineering Field Activity West, 1997
Metals					
Arsenic	1.04	5.7	Multiple	Growth	USEPA, 2005a
Cadmium	0.77	7.1	Multiple	Growth	USEPA, 2005b
Chromium	2.4	35	Multiple	Reproduction, Growth	USEPA, 2008a
Copper	5.6	56	Multiple	Reproduction, Growth	USEPA, 2007a
Lead	4.7	47	Multiple	Reproduction, Growth	USEPA, 2005c
Mercury[6]	1	10	Mink	Reproduction	Sample et al., 1996
Nickel	1.7	13	Multiple	Reproduction	USEPA, 2007d
Selenium	0.143	0.8	Multiple	Growth	USEPA, 2007f
Silver	6.02	60.2	Multiple	Reproduction, Growth	USEPA, 2006
Zinc	9.61	292	Rat	Reproduction, Growth	USEPA, 2007g

Notes

[1] TRVs for total PCBs for piscivorous mammals used for mink and TRVs for non-piscivorous mammals used for all other mammalian receptors.

[2] BHC mixed isomers TRVs used for all isomers.

[3] Endosulfan TRVs used for alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

[4] Endrin TRVs used for endrin aldehyde and endrin ketone.

[5] Heptachlor TRVs used for heptachlor epoxide.

[6] Mercuric chloride TRVs used for mercury.

Table 5-32: Summary of Hazard Quotients for Tissue Residue Evaluation

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Exposure Pathway	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Invertebrate: Asiatic Clam - Tissue																
Total PCB Aroclors	19	2	19	2	19	2	19	2	19	2	19	2	2	0.2	19	2
TCDD TEQ (PCBs) (fish)	0.01	0.001	0.01	0.001	0.01	0.001	0.01	0.001	0.0096	0.001	0.01	0.001	0.005	0.0005	0.01	0.001
Invertebrate: Crayfish - Tissue																
Total PCB Aroclors	13	1	13	1	13	1	13	1	13	1	13	1	20	2	13	1
Arsenic	37	4	37	4	37	4	37	4	37	4	37	4	--	--	37	4
Cadmium	11	1	11	1	11	1	11	1	11	1	11	1	26	3	11	1
Chromium	6	1	6	1	6	1	6	1	6	1	6	1	--	--	6	1
Copper	1	0.06	1	0.06	1	0.06	1	0.06	1	0.06	1	0.06	0.4	0.04	1	0.1
Lead	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	2	0.2	7	1	2	0.2
Mercury	9	1	9	1	9	1	9	1	9	1	9	0.9	11	1	9	1
Nickel	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4	--	--	4	0.4
Selenium	46	5	46	5	46	5	46	5	46	5	46	5	29	3	46	5
Silver	63	6	63	6	63	6	63	6	63	6	63	6	22	2	63	6
Zinc	27	3	27	3	27	3	27	3	27	3	27	3	22	2	27	3
Predatory Fish - Tissue																
Total DDx	0.4	0.04	0.4	0.04	0.4	0.04	0.4	0.04	1	0.07	1	0.08	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	450	45	450	45	450	45	450	45	904	90	979	98	40	4	96	10
TCDD TEQ (PCBs) (fish)	1	0.1	1	0.1	1	0.1	1	0.1	1	0.08	3	0.3	0.1	0.01	0.3	0.03
Arsenic	11	1	11	1	11	1	11	1	--	--	1	0.1	--	--	--	--
Cadmium	112	11	112	11	112	11	112	11	77	8	71	7	--	--	--	--
Chromium	--	--							--	--	--	--	--	--	--	--
Copper	6	1	6	1	6	1	6	1	5	0.5	9	1	5	1	--	--
Lead	24	2	24	2	24	2	24	2	23	2	19	2	23	2	--	--
Mercury	8	1	8	1	8	1	8	1	8	1	30	3	5	1	--	--
Nickel	--	--							--	--	--	--	--	--	--	--
Selenium	57	6	57	6	57	6	57	6	78	8	80	8	85	9	--	--
Silver	19	2	19	2	19	2	19	2	18	2	16	2	21	2	--	--
Zinc	50	5	50	5	50	5	50	5	71	7	65	6	47	5	--	--
Bottom-feeder Fish - Tissue																
Total PCB Aroclors	789	79	789	79	789	79	789	79	749	75	2674	267	891	89	926	93
TCDD TEQ (PCBs) (fish)	6	0.6	6	0.6	6	1	6	1	1	0.09	9	1	0.1	0.01	1	0
Predatory Fish - Egg Residue																
TCDD TEQ (PCBs) (fish)	0.2	0.02	0.2	0.02	0.2	0.02	0.2	0.02	0.2	0.02	0.7	0.06	0.02	0.002	0.1	0.01
Bottom-feeder Fish - Egg Residue																
TCDD TEQ (PCBs) (fish)	1	0.09	1	0.09	1	0.09	1	0.09	0.2	0.0	2	0.1	0.02	0.002	0.1	0.01
Bird Egg (Preditory Fish Tissue)																
Total DDx	0.3	0.03	0.3	0.03	0.3	0.03	0.3	0.03	0.5	0.045	0.5	0.05	--	--	--	--
Total PCB Aroclors	181	18	181	18	181	18	181	18	365	37	395	40	16	2	39	4
TCDD TEQ (PCBs) (Bird)	1,557	156	1,557	156	1,557	156	1,557	156	1,536	154	4,672	467	247	25	494	49
Bird Egg (bottom-feeder Fish Tissue)																
Total PCB Aroclors	318	32	318	32	318	32	318	32	302	30	1,078	109	359	36	373	38
TCDD TEQ (PCBs) (Bird)	6,865	686	6,865	686	6,865	686	6,865	686	1,788	179	11,925	1,193	190	19	1,446	145

Table 5-33: Summary of Biota-Sediment Bioaccumulation Data
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

OU4 Study Area Location:		BB-SD01			BB-SD02			BB-SD03		
Compound	**Units**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**
Total PCBs	pg/g	41,047,494	27,435,721	1.47	6,009,715	3,751,296	2.30	20,000,000	23,635,958	3.34
Fraction Organic Carbon (f_{oc})	g/g	0.045			0.067			0.058		
Fraction Lipids (f_{lipids})	g/g		0.020			0.018			0.020	

OU4 Study Area Location:		NMP-SD01			NMP-SD02		
Compound	**Units**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**
Total PCBs	pg/g	3,510,000	989,474	0.73	4,850,000	1,291,373	0.63
Fraction Organic Carbon (f_{oc})	g/g	0.048			0.041		
Fraction Lipids (f_{lipids})	g/g		0.018			0.017	

Reference Location:		AB-SD01			LN-SD01		
Compound	**Units**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**	**Sediment Concentration**	**Tissue Concentration**	**Normalized BSAF (Tissue/Lipids) / (Sediment/TOC)**
Total PCBs	pg/g	112,845	57,945	0.71	441,061	224,112	2.13
Fraction Organic Carbon (f_{oc})	g/g	0.025			0.069		
Fraction Lipids (f_{lipids})	g/g		0.018			0.016	

Notes
BB-SD01 - RM6.51 in EU BB5
BB-SD02 - RM4.85 in EU BB3
BB-SD-03 - RM3.01 in EU BB1
NMP-SD01 - west end of New Market Pond
NMP-SD02 - east end of New Market Pond
AB-SD01 - Ambrose Brook Sediment Location
LN-SD01 - Lake Nelson Sediment Location
BSAF = biota-sediment bioaccumulation factor

Table 5-34: Summary of SEM-AVS Data for Representative Site and Reference Area Sediment Samples
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

		Location	BB1		BB2		BB3		BB4			BB5	Reference Area									
		Sample Date	6/22/2011	7/27/2011	6/8/2011	6/8/2011	7/19/2011	8/4/2011	6/21/2011	7/7/2011	7/8/2011	7/29/2011	8/2/2012	8/1/2012	8/1/2012	8/1/2012	8/1/2012	8/1/2012	8/1/2012	8/2/2012	8/3/2012	8/3/2012
		Sample ID	BB-T115A	BB-T075A	NMP-T003C	NMP-T017B	BB-T255A	BB-T231C	BB-T282A	BB-T309A	BB-T328B	BB-T353B	AB-SD01	AB-SD02	AB-SD03	AB-SD04	AB-SD05	AB-SD06	AB-SD07	LN-SD01	LN-SD02	LN-SD03
Analyte	CAS No.	Units																				
Acid-Volatile Sulfide	18496-25-8	μmol/g_{sed}	4.2 E	0.312 U	32.9 E	13.8 E	3.83	98.8 M	0.451 E	1.24	2.45	0.396	134 E	1.71 E	1.38 E	0.312 UE	5.3 E	0.655 E	2.6 E	46.3 E	48 E	5.47 E
Cadmium	7440-43-9	μmol/g_{sed}	0.0105 E	0.0049 E	0.0879 E	0.256 E	0.0311	0.0843 E	0.0047 E	0.0162	0.0087	0.0108 E	0.0186 E	0.0018 E	0.002 E	0.00158 E	0.0028 E	0.00116 E	0.00124 E	0.0167 E	0.00987 E	0.00333 E
Copper	7440-50-8	μmol/g_{sed}	0.239	0.0898	0.385 E	0.16 E	0.284	0.274 M	0.0384 E	0.2216	0.2115	0.1377	0.233 E	0.159 E	0.119 E	0.177 E	0.214 E	0.0579 E	0.0514 E	0.596 E	0.805 E	0.163 E
Lead	7439-92-1	μmol/g_{sed}	0.12 E	0.0547	0.614 E	0.175 E	0.2674	0.873 M	0.0526 E	0.1276	0.0855	0.0589	0.486 M	0.0739	0.0546	0.0406	0.128	0.058	0.037	0.406 M	0.283 M	0.0844
Nickel	7440-02-0	μmol/g_{sed}	0.118 E	0.0293	0.146 E	0.0585 E	0.0591	0.192 M	0.019 E	0.0731	0.0681	0.0418	0.295 E	0.0494 E	0.051 E	0.0303 E	0.0852 E	0.0362 E	0.0187 E	0.128 E	0.153 E	0.0704 E
Zinc	7440-66-6	μmol/g_{sed}	1.16 E	0.519 E	6.078 E	1.99 E	1.758	4.938 E	0.459 E	1.334	1.082	0.776 E	8.7 M	0.979	0.805	0.65	1.67	0.621	0.385	5.77 M	5.07 M	1.45
Mercury	7439-97-6	μmol/g_{sed}	5E-05 U	5E-05 U	5E-05 M	0.00005 U	5E-05 U	5E-05 M	5E-05 U	5E-05 U	5E-05 U	5E-05 U	0.00005 M	5E-05 U	5E-05 U	0.00005 UE	0.00005 U	0.00005 U	0.00005 U	0.00005 M	0.00005 M	0.00005 U
f_{oc}		g_{oc}/g_{sed}	0.00609 E	0.017	0.0508 M	0.0088 E	0.0725 E	0.139 M	0.0311 E	0.0181	0.00156	0.00297	0.0247	0.00202	0.00256	0.00193	0.00582	0.00326	0.00135	0.0687	0.0422	0.00271
∑SEM [1]		μmol/g_{sed}	1.65	0.70	7.31	2.64	2.40	6.36	0.57	1.77	1.46	1.03	9.73	1.26	1.03	0.90	2.10	0.77	0.49	6.92	6.32	1.77
∑SEM/AVS [2, 3]		---	0.4	2	0.2	0.2	0.6	0.1	1	1	0.6	3	0.1	0.7	0.7	3	0.4	1	0.2	0.1	0.1	0.3
∑SEM-AVS [2]		μmol/g_{sed}	-2.55	0.39	-25.59	-11.16	-1.43	-92.44	0.12	0.53	-0.99	0.63	-124.27	-0.45	-0.35	0.59	-3.20	0.12	-2.11	-39.38	-41.68	-3.70
(∑SEM-AVS)/f_{oc} [4]		μmol/g_{oc}	-419	23	-504	-1268	-20	-665	4	29	-637	212	-5031	-221	-136	304	-550	37	-1560	-573	-988	-1365

Notes:
AVS = acid volatile sulfides
E = Quantitation is approximate (estimated) due to limitations identified during the quality assurance/quality control review.
f_{oc} = fraction organic carbon
M = Project-specific qualifier marking samples with high percent moisture, which may impact quantification, but no other data quality issues are associated with the sample.
N = There is presumptive evidence to make a tentative identification of the compound.
SEM = simultaneously extracted metals
U = The compound/analyte was analyzed for but the result was negated by the validator since it was detected in a blank at a similar level.
UE = This compound/analyte was not detected (or was negated by the validator) but the quantitation/detection limit is uncertain due to quality assurance/quality control issues identified during data validation.
1 = ∑SEM is the total detected cadmium, copper, lead, nickel, and zinc concentrations.
2 = If AVS was detected less than the reporting limit, then the reporting limit was used in the subsequent calculations.
3 = For ∑SEM/AVS ratios above 1.0, the potential exists for metal toxicity since sufficient AVS to completely form insoluble metal sulfides is not present.
4 = For (∑SEM-AVS)/f_{oc} ratios ≤ 130 μmol/g_{oc}, the metals are predicted to be non-toxic; for ratios between 130 and 3,000 μmol/ $_{goc,}$ the prediction of metals toxicity is uncertain; and for ratios greater than 3,000 μmol/g $_{oc}$, the metals are predicted to be toxic (USEPA, 2005f).

Table 5-35: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Wood Duck																
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	--	--	--	--	--	--
alpha-BHC	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
beta-BHC	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
delta-BHC	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chlordane, Total	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--
alpha-Endosulfan	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--	--	--
beta-Endosulfan	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Endrin	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Endrin aldehyde	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Endrin ketone	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Heptachlor	--	--	<1	<1	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	--	--
Arsenic	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Cadmium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Chromium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	--	--	<1	<1	<1	<1	<1	<1	--	--	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	1	<1	<1	<1	1	<1	1	<1	--	--	--	--
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1	--	--

Table 5-35: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Mallard																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	2	<1	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
TCDD TEQ (PCBs)	1	<1	1	<1	<1	<1	1	<1	1	<1	<1	<1	<1	<1	1	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	1	<1	**2**	<1	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Red-Winged Blackbird																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	**13**	1	**13**	1	**13**	1	**13**	1	**13**	1	**13**	1	**8**	1	**13**	1
TCDD TEQ (PCBs)	**8**	1	**8**	1	**8**	1	**8**	1	**8**	1	**8**	1	1	<1	**8**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**9**	1	**9**	1	**9**	1	**9**	1	**9**	1	**9**	1	**7**	1	**9**	1
Lead	<1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	**2**	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**3**	1	**3**	1	**3**	1	**3**	1	**3**	1	**2**	<1	**3**	1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 5-35: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Birds
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
COPEC	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Great Blue Heron																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**15**	**2**	**16**	**2**	**16**	**2**	**16**	**2**	**21**	**2**	**46**	**5**	**12**	1	**13**	1
TCDD TEQ (PCBs)	**5**	1	**5**	1	**5**	1	**5**	1	**3**	<1	**12**	1	<1	<1	**2**	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Belted Kingfisher																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**30**	**3**	**30**	**3**	**30**	**3**	**30**	**3**	**39**	**4**	**84**	**8**	**22**	**2**	**25**	**2**
TCDD TEQ (PCBs)	**11**	1	**11**	1	**11**	1	**11**	1	**6**	1	**23**	**2**	1	<1	**4**	<1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**2**	<1	**2**	<1	**2**	<1	**2**	<1	**2**	<1	**2**	<1	1	<1	**2**	<1
Lead	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**2**	<1	**2**	<1	**2**	<1	**2**	1	**2**	1	**2**	1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table 5-36: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
COPEC	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Muskrat																
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HMW PAHs	<1	<1	**4**	1	**3**	1	**4**	1	**2**	<1	**2**	<1	1	<1	**5**	1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	--	--	--	--	--	--
alpha-BHC	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
beta-BHC	--	--	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
delta-BHC	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chlordane, Total	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	**2**	<1	--	--	**17**	<1	1	<1	**28**	<1	**2**	<1	--	--
alpha-Endosulfan	--	--	<1	<1	<1	<1	1	<1	<1	<1	--	--	--	--	--	--
beta-Endosulfan	--	--	--	--	--	--	<1	<1	<1	<1	**5**	<1	<1	<1	--	--
Endosulfan sulfate	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Endrin	--	--	<1	<1	1	<1	1	<1	1	<1	**3**	<1	--	--	--	--
Endrin aldehyde	--	--	<1	<1	--	--	<1	<1	<1	<1	1	<1	--	--	--	--
Endrin ketone	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Heptachlor	--	--	<1	<1	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Total PCB Aroclors	<1	<1	1	<1	1	<1	1	<1	**2**	<1	**5**	1	<1	<1	--	--
Arsenic	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Cadmium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Chromium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	--	--	<1	<1	<1	<1	<1	<1	--	--	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	--	--	**2**	<1	--	--	**2**	<1	1	<1	1	<1	1	<1	--	--

Table 5-36: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
COPEC	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Raccoon																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	1	<1	1	<1	1	<1	1	<1	**2**	<1	1	<1	1	<1
TCDD TEQ (PCBs)	**7**	1	**7**	1	**7**	1	**7**	1	**5**	1	**8**	1	1	<1	**5**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1	1	<1
Little-Brown Bat																
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxyclor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**5**	<1	**3**	<1	**5**	<1
TCDD TEQ (PCBs)	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**27**	**3**	**3**	<1	**27**	**3**
Arsenic	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	--	--	1	<1
Cadmium	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	2	<1	1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	**7**	1	**7**	1	**7**	1	**7**	1	**7**	1	**7**	1	**5**	1	**7**	1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	**5**	1	**5**	1	**5**	1	**5**	1	**5**	1	**3**	1	**5**	1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**3**	<1	**2**	<1	**3**	<1

Table 5-36: Summary of Hazard Quotients for Food Web Modeling - Semi-Aquatic Mammals
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6		EU SL	
COPEC	HQ		HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
American Mink																
Total DDx	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Dieldrin	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Methoxyclor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
Total PCB Aroclors	**14**	**7**	**14**	**7**	**14**	**7**	**14**	**7**	**19**	**9**	**42**	**20**	**11**	**5**	**12**	**6**
TCDD TEQ (PCBs)	**39**	**4**	**39**	**4**	**39**	**4**	**39**	**4**	**11**	1	**71**	**7**	**2**	<1	**6**	1
Arsenic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Cadmium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mercury	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--	<1	<1
Selenium	--	--	1	<1	1	<1	1	<1	**2**	<1	**2**	<1	**2**	<1	<1	<1
Silver	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table 5-37: Summary of Hazard Quotients for Food Web Modeling - Terrestrial Birds

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB HQ NOAEL	EU GB HQ LOAEL	EU BB1 HQ NOAEL	EU BB1 HQ LOAEL	EU BB2 HQ NOAEL	EU BB2 HQ LOAEL	EU BB3 HQ NOAEL	EU BB3 HQ LOAEL	EU BB4 HQ NOAEL	EU BB4 HQ LOAEL	EU BB5 HQ NOAEL	EU BB5 HQ LOAEL	EU BB6 HQ NOAEL	EU BB6 HQ LOAEL
Mourning Dove														
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
beta-BHC	--	--	--	--	--	--	<1	<1	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	--	--	<1	<1	<1	<1	--	--
Chlordane, Total	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Endrin ketone	--	--	--	--	--	--	<1	<1	--	--	--	--	<1	<1
beta-Endosulfan	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Heptachlor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Methoxyclor	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Mercury	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	--	--
Silver	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Zinc	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
American Robin														
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	1	<1	**10**	1	**9**	1	**43**	**4**	**31**	**3**	**395**	**40**	**732**	**73**
Red-Tailed Hawk														
Total DDx	--	--	--	--	--	--	--	--	--	--	<1	<1	<1	<1
Dieldrin	--	--	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table 5-38: Summary of Hazard Quotients for Food Web Modeling - Terrestrial Mammals

Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

COPEC	EU GB		EU BB1		EU BB2		EU BB3		EU BB4		EU BB5		EU BB6	
	HQ		HQ		HQ		HQ		HQ		HQ		HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Eastern Gray Squirrel														
HMW PAHs	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1
Aldrin	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
beta-BHC	--	--	--	--	--	--	<1	<1	--	--	<1	<1	--	--
gamma-BHC	--	--	<1	<1	--	--	--	--	<1	<1	<1	<1	--	--
Chlordane, Total	--	--	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Total DDx	--	--	<1	<1	--	--	<1	<1	<1	<1	1	<1	<1	<1
Dieldrin	--	--	<1	<1	--	--	<1	<1	1	<1	**19**	<1	<1	<1
Endrin aldehyde	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Endrin ketone	--	--	--	--	--	--	<1	<1	--	--	--	--	<1	<1
beta-Endosulfan	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Heptachlor	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
Methoxyclor	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<1	<1	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Copper	--	--	--	--	--	--	1	<1	<1	<1	<1	<1	--	--
Lead	--	--	<1	<1	--	--	1	<1	<1	<1	<1	<1	--	--
Mercury	<1	<1	<1	<1	--	--	<1	<1	<1	<1	<1	<1	--	--
Selenium	--	--	<1	<1	<1	<1	1	<1	<1	<1	1	<1	--	--
Silver	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1	--	--
Zinc	1	<1	--	--	--	--	**2**	<1	1	<1	1	<1	--	--
Short-Tailed Shrew														
Total DDx	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCB Aroclors	<1	<1	**2**	<1	**2**	<1	**9**	1	**32**	**3**	**82**	**8**	**152**	**15**
Red Fox														
Total DDx	--	--	--	--	--	--	--	--	--	--	<1	<1	<1	<1
Dieldrin	--	--	--	--	--	--	--	--	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	--	--	--	--	--	--	--	--	<1	<1	--	--	--	--
Total PCB Aroclors	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

-- Indicates not calculated because not a COPEC or not detected.

Table 6-1: Total PCB Concentrations in Residential Soils within the OU4 Study Area
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Residential Address	Detection Frequency	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	95% UCL Concentration (mg/kg)
1126 Belmont Avenue	19/22	0.018	0.63	--
221 Schillaci Lane	3/22	0.013	0.033	--
230 Oakmoor Avenue	2/22	0.046	0.085	--
251 Oakmoor Avenue	5/26	0.026	0.67	--
345 Metuchen	30/30	0.24	2.0	0.88
Across from 405 Spicer Avenue	17/19	0.005	0.33	--
320 Spicer Avenue	19/22	0.080	4.5	1.7
405 Spicer Avenue	15/21	0.043	0.45	--
Block 126, Lots 9/10/11 (along Spicer Avenue)	25/25	0.010	3.2	0.71
130 Kaine Avenue	11/16	0.018	0.32	--
334 Hamilton Boulevard	12/12	0.044	4.3	2.6
713 New Market Avenue	13/16	0.063	0.59	--
1112 Belmont Avenue	12/12	0.042	4.8	2.3
315 Delmore Avenue	13/16	0.021	1.0	--
Arlington Avenue	16/23	0.016	0.29	--
321 Hancock Street	19/20	0.0088	1.1	0.61

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	2.05	BB1	White sucker	WS-A13-1	320	355.1	1.1
1997	2.05	BB1	Largemouth bass	BS-A13-2	300	295.3	1.1
1997	2.05	BB1	White sucker	WS-A13-2	293	277.2	1.1
1997	2.05	BB1	White sucker	WS-A13-1	270	260.2	1.3
1997	2.05	BB1	Largemouth bass	BS-A13-1	195	102.1	1.4
1997	2.05	BB1	Carp	CC-A13-1	565	2860.6	1.6
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-1-B	115	30.3	2.0
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-2-A	123	38.1	2.0
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-2-C	116	33.2	2.1
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-1-A	122	41.5	2.3
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-1-C	105	26.5	2.3
1997	2.05	BB1	Pumpkinseed sunfish	PS-A13-2-B	105	28.3	2.4
1997	3.26	BB1	White sucker	WS-A12-3	230	135.6	1.1
1997	3.26	BB1	White sucker	WS-A12-1	285	284.4	1.2
1997	3.26	BB1	White sucker	WS-A12-2	250	192.1	1.2
1997	3.26	BB1	Brown bullhead	BH-A12-1	220	150.5	1.4
1997	3.26	BB1	Largemouth bass	BS-A12-2	195	106.9	1.4
1997	3.26	BB1	Largemouth bass	BS-A12-1	235	193.9	1.5
1997	3.26	BB1	Carp	CC-A12-2	570	2939.3	1.6
1997	3.26	BB1	Pumpkinseed sunfish	PS-A12-2-B	130	37.6	1.7
1997	3.26	BB1	Carp	CC-A12-1	440	1473.4	1.7
1997	3.26	BB1	Carp	CC-A12-3	520	2919.9	2.1
1997	3.26	BB1	Pumpkinseed sunfish	PS-A12-2-A	130	47	2.1
1997	3.26	BB1	Pumpkinseed sunfish	PS-A12-1-A	130	48.4	2.2
1997	3.26	BB1	Pumpkinseed sunfish	PS-A12-3	125	84.1	4.3
1997	3.41	BB1	White sucker	WS-A11-2	305	237.4	0.8
1997	3.41	BB1	White sucker	WS-A11-3	280	224.3	1.0
1997	3.41	BB1	White sucker	WS-A11-1	275	252.6	1.2
1997	3.41	BB1	Largemouth bass	BS-A11-1	310	382.5	1.3
1997	3.41	BB1	Brown bullhead	BH-A11-1	310	421.8	1.4
1997	3.41	BB1	Brown bullhead	BH-A11-3	235	189.3	1.5
1997	3.41	BB1	Carp	CC-A11-1	503	1917.7	1.5
1997	3.41	BB1	Largemouth bass	BS-A11-2	255	268.4	1.6
1997	3.41	BB1	Carp	CC-A11-3	630	4100	1.6
1997	3.41	BB1	Brown bullhead	BH-A11-2	270	322.8	1.6
1997	3.41	BB1	Largemouth bass	BS-A11-3	206	148.4	1.7
1997	3.41	BB1	Carp	CC-A11-2	590	3520.1	1.7
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-3	125	36.6	1.9
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-2	125	38	1.9
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-3	115	29.6	1.9
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-1	125	38.4	2.0
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-2	115	30.6	2.0
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-3	115	31.4	2.1
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-1	115	32.4	2.1
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-2	115	32.5	2.1
1997	3.41	BB1	Pumpkinseed sunfish	PS-A11-1	130	49.5	2.3

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	3.52	BB2	Largemouth bass	A6-LB-2	410	1007.6	1.5
1997	3.52	BB2	Largemouth bass	A6-LB-1	300	431.1	1.6
2008	3.71	BB2	White sucker	6-WS-2	320	373.8	1.1
2008	3.71	BB2	White sucker	6-WS-1	330	415.4	1.2
2008	3.71	BB2	White sucker	6-WS-3	255	196	1.2
2008	3.71	BB2	Carp	6-C-5	580	2800	1.4
2008	3.71	BB2	Carp	6-C-8	420	1107	1.5
2008	3.71	BB2	Carp	6-C-3	550	2659	1.6
2008	3.71	BB2	Carp	6-C-6	420	1186	1.6
2008	3.71	BB2	Carp	6-C-4	640	4274	1.6
2008	3.71	BB2	Carp	6-C-2	480	1834	1.7
2008	3.71	BB2	Carp	6-C-1	600	4019	1.9
2008	3.71	BB2	Bluegill sunfish	6-BG-3-1	132	45.1	2.0
2008	3.71	BB2	Bluegill sunfish	6-BG-2-4	147	64.1	2.0
2008	3.71	BB2	Bluegill sunfish	6-BG-4-2	162	85.9	2.0
2008	3.71	BB2	Bluegill sunfish	6-BG-1-4	175	108.7	2.0
2008	3.71	BB2	Bluegill sunfish	6-BG-3-4	105	23.7	2.0
2008	3.71	BB2	Carp	6-C-7	330	739	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-3-2	130	45.7	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-4-5	162	88.9	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-5-2	163	90.7	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-4-3	162	89.9	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-5-4	153	75.8	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-3-5	124	40.5	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-5-1	167	99.2	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-5-5	172	109.2	2.1
2008	3.71	BB2	Bluegill sunfish	6-BG-2-3	157	83.5	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-4-1	135	53.6	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-1-5	175	117	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-1-2	170	107.7	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-2-5	141	61.6	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-5-3	155	82.7	2.2
2008	3.71	BB2	Bluegill sunfish	6-BG-3-3	106	26.9	2.3
2008	3.71	BB2	Bluegill sunfish	6-BG-1-3	165	104.8	2.3
2008	3.71	BB2	Bluegill sunfish	6-BG-4-4	143	68.5	2.3
2008	3.71	BB2	Bluegill sunfish	6-BG-2-1	155	87.6	2.4
2008	3.71	BB2	Bluegill sunfish	6-BG-1-1	169	114.3	2.4
2008	3.71	BB2	Bluegill sunfish	6-BG-2-2	148	83.4	2.6

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	4.15	BB3	White sucker	A5-WS-1	390	608	1.0
1997	4.15	BB3	White sucker	A5-WS-2	400	667.9	1.0
1997	4.15	BB3	White sucker	A5-WS-3	360	536.4	1.1
1997	4.15	BB3	Largemouth bass	A5-LB-1	365	625.5	1.3
1997	4.15	BB3	Largemouth bass	A5-LB-2	265	242	1.3
1997	4.15	BB3	Largemouth bass	A5-LB-3	242	209	1.5
1997	4.15	BB3	Brown bullhead	A5-BH-1	300	401.5	1.5
1997	4.15	BB3	Pumpkinseed sunfish	A5-PS-1	142	59.9	2.1
1997	4.15	BB3	Pumpkinseed sunfish	A5-PS-3	140	70.5	2.6
1997	4.15	BB3	Pumpkinseed sunfish	A5-PS-2	138	68.8	2.6
1997	4.62	BB3	Pumpkinseed sunfish	A4-PS-1	140	54.8	2.0
1997	4.62	BB3	Pumpkinseed sunfish	A4-PS-2	130	56.6	2.6
1997	5.15	BB3	White sucker	A3-WS-3	340	397.8	1.0
1997	5.17	BB3	White sucker	A3-WS-1	380	63.1	0.1
1997	5.17	BB3	White sucker	A3-WS-2	350	459.5	1.1
1997	5.17	BB3	Pumpkinseed sunfish	A3-PS-2	150	80.7	2.4
1997	5.17	BB3	Pumpkinseed sunfish	A3-PS-1	160	110.1	2.7
1997	5.17	BB3	Pumpkinseed sunfish	A3-PS-3	110	40.7	3.1
2008	5.19	BB3	White sucker	5-WS-8	407	702	1.0
2008	5.19	BB3	White sucker	5-WS-2	227	124.1	1.1
2008	5.19	BB3	White sucker	5-WS-1	218	111.5	1.1
2008	5.19	BB3	White sucker	5-WS-4	308	318	1.1
2008	5.19	BB3	White sucker	5-WS-6	382	622.3	1.1
2008	5.19	BB3	White sucker	5-WS-5	331	410	1.1
2008	5.19	BB3	White sucker	5-WS-3	268	224.3	1.2
2008	5.19	BB3	White sucker	5-WS-7	344	499.8	1.2
2008	5.19	BB3	Bluegill sunfish	5-BG-3-4	163	86.5	2.0
2008	5.19	BB3	Bluegill sunfish	5-BG-2-1	170	106.6	2.2
2008	5.19	BB3	Bluegill sunfish	5-BG-3-5	143	64.8	2.2
2008	5.19	BB3	Bluegill sunfish	5-BG-3-3	151	76.7	2.2
2008	5.19	BB3	Bluegill sunfish	5-BG-3-2	140	61.9	2.3
2008	5.19	BB3	Bluegill sunfish	5-BG-1-3	171	113.7	2.3
2008	5.19	BB3	Bluegill sunfish	5-BG-2-4	174	127.3	2.4
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-1	136	60.8	2.4
2008	5.19	BB3	Bluegill sunfish	5-BG-1-1	170	119.1	2.4
2008	5.19	BB3	Bluegill sunfish	5-BG-2-2	182	148.4	2.5
2008	5.19	BB3	Bluegill sunfish	5-BG-2-3	173	127.6	2.5
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-4	160	101.4	2.5
2008	5.19	BB3	Bluegill sunfish	5-BG-1-4	164	109.3	2.5
2008	5.19	BB3	Bluegill sunfish	5-BG-3-1	142	71.4	2.5
2008	5.19	BB3	Bluegill sunfish	5-BG-1-2	168	118.5	2.5
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-6	138	68.4	2.6
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-3	152	91.7	2.6
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-1	141	74.2	2.6
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-2	141	74.7	2.7
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-3	147	86.3	2.7
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-5	141	76.8	2.7
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-4	134	66.4	2.8
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-5	156	105.9	2.8
2008	5.19	BB3	Pumpkinseed sunfish	5-P-1-6	155	105.1	2.8
2008	5.19	BB3	Pumpkinseed sunfish	5-P-2-2	130	62.5	2.8

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	5.64	BB4	White sucker	A2-WS-2	330	392	1.1
1997	5.64	BB4	White sucker	A2-WS-3	310	331	1.1
1997	5.64	BB4	White sucker	A2-WS-1	380	654	1.2
1997	5.64	BB4	Pumpkinseed sunfish	A2-PS-2	120	39.2	2.3
1997	5.64	BB4	Pumpkinseed sunfish	A2-PS-1	130	67.1	3.1
2008	5.66	BB4	White sucker	4-WS-5	207	89	1.0
2008	5.66	BB4	White sucker	4-WS-7	244	149.5	1.0
2008	5.66	BB4	White sucker	4-WS-6	250	161.6	1.0
2008	5.66	BB4	White sucker	4-WS-8	268	212.4	1.1
2008	5.66	BB4	White sucker	4-WS-2	172	56.2	1.1
2008	5.66	BB4	White sucker	4-WS-4	205	95.3	1.1
2008	5.66	BB4	White sucker	4-WS-1	155	41.3	1.1
2008	5.66	BB4	White sucker	4-WS-3	194	82.6	1.1
2008	5.66	BB4	Pumpkinseed sunfish	4-P-3-5	146	54.3	1.7
2008	5.66	BB4	Pumpkinseed sunfish	4-P-4-5	136	55.7	2.2
2008	5.66	BB4	Pumpkinseed sunfish	4-P-3-3	136	56	2.2
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-1	98	21	2.2
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-6	101	23.1	2.2
2008	5.66	BB4	Pumpkinseed sunfish	4-P-3-2	124	43.2	2.3
2008	5.66	BB4	Pumpkinseed sunfish	4-P-4-4	123	44.8	2.4
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-4	116	38.1	2.4
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-5	98	23	2.4
2008	5.66	BB4	Pumpkinseed sunfish	4-P-4-1	131	55.3	2.5
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-7	118	41.3	2.5
2008	5.66	BB4	Pumpkinseed sunfish	4-P-4-2	137	66.5	2.6
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-3	112	36.9	2.6
2008	5.66	BB4	Pumpkinseed sunfish	4-P-3-1	141	74.2	2.6
2008	5.66	BB4	Pumpkinseed sunfish	4-P-3-4	120	45.9	2.7
2008	5.66	BB4	Pumpkinseed sunfish	4-P-2-1	151	91.9	2.7
2008	5.66	BB4	Pumpkinseed sunfish	4-P-4-3	132	62.8	2.7
2008	5.66	BB4	Pumpkinseed sunfish	4-P-2-3	148	89.1	2.7
2008	5.66	BB4	Pumpkinseed sunfish	4-P-1-2	103	30.2	2.8
2008	5.66	BB4	Pumpkinseed sunfish	4-P-2-2	146	87.8	2.8

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
2008	6.32	BB5	White sucker	3-WS-5	352	455.7	1.0
2008	6.32	BB5	White sucker	3-WS-4	322	361.8	1.1
2008	6.32	BB5	White sucker	3-WS-3	324	375	1.1
2008	6.32	BB5	White sucker	3-WS-7	378	616.1	1.1
2008	6.32	BB5	White sucker	3-WS-2	225	131.1	1.2
2008	6.32	BB5	White sucker	3-WS-1	207	104.5	1.2
2008	6.32	BB5	White sucker	3-WS-8	371	602.7	1.2
2008	6.32	BB5	White sucker	3-WS-6	324	438.6	1.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-3-3	130	47	2.1
2008	6.32	BB5	Pumpkinseed sunfish	3-P-3-1	134	51.7	2.1
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-3	104	24.5	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-1	101	22.7	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-6	94	18.4	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-4-3	134	53.4	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-4-1	141	62.6	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-7	96	19.9	2.2
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-5	103	24.9	2.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-2	107	28.1	2.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-2-4	124	44	2.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-1-4	109	29.9	2.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-3-5	133	55.1	2.3
2008	6.32	BB5	Pumpkinseed sunfish	3-P-4-5	137	60.7	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-3-2	130	52.1	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-2-1	115	36.2	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-2-2	115	36.3	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-4-4	137	61.7	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-5-1	151	83.1	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-4-2	137	62.6	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-5-4	150	82.2	2.4
2008	6.32	BB5	Pumpkinseed sunfish	3-P-2-3	120	43	2.5
2008	6.32	BB5	Pumpkinseed sunfish	3-P-5-3	143	72.8	2.5
2008	6.32	BB5	Pumpkinseed sunfish	3-P-5-4	147	79.1	2.5
2008	6.32	BB5	Pumpkinseed sunfish	3-P-3-4	136	65.5	2.6
2008	6.32	BB5	Pumpkinseed sunfish	3-P-5-2	144	78.1	2.6
2008	6.5	BB5	White sucker	2-WS-5	181	56.9	1.0
2008	6.5	BB5	White sucker	2-WS-7-1	158	38.4	1.0
2008	6.5	BB5	White sucker	2-WS-3	185	64.6	1.0
2008	6.5	BB5	White sucker	2-WS-1	277	222.9	1.0
2008	6.5	BB5	White sucker	2-WS-6-3	153	37.7	1.1
2008	6.5	BB5	White sucker	2-WS-6-1	137	27.3	1.1
2008	6.5	BB5	White sucker	2-WS-7-2	155	41.5	1.1
2008	6.5	BB5	White sucker	2-WS-2	234	142.9	1.1
2008	6.5	BB5	White sucker	2-WS-6-2	151	38.4	1.1
2008	6.5	BB5	White sucker	2-WS-4	187	78	1.2
2008	6.5	BB5	White sucker	2-WS-8	93	9.8	1.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-2	108	20.7	1.6
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-6	106	25.3	2.1
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-5	94	17.9	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-3-5	128	45.9	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-7	108	27.6	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-12	92	17.1	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-8	113	31.7	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-3-2	133	51.7	2.2

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-6	117	35.2	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-3-3	132	51	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-11	107	27.2	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-3	104	25	2.2
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-3	124	43.1	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-5-5	146	70.5	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-4	106	27.3	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-10	106	27.3	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-6	139	61.6	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-5	111	31.6	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-1	96	20.5	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-3-1	129	49.9	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-4	129	50.1	2.3
2008	6.5	BB5	Pumpkinseed sunfish	2-P-5-4	143	69	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-5	136	59.4	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-3-4	128	49.7	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-5-3	146	75.4	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-4	147	77.1	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-5-1	148	78.7	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-2	117	39	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-1	138	64	2.4
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-3	138	65.3	2.5
2008	6.5	BB5	Pumpkinseed sunfish	2-P-2-9	97	22.7	2.5
2008	6.5	BB5	Pumpkinseed sunfish	2-P-1-1	123	46.7	2.5
2008	6.5	BB5	Pumpkinseed sunfish	2-P-4-2	141	71.7	2.6
2008	6.5	BB5	Pumpkinseed sunfish	2-P-5-2	140	72.1	2.6
1997	6.54	BB5	Carp	A1-CC-1	580	482	0.2
1997	6.54	BB5	Carp	A1-CC-2	570	539	0.3
1997	6.54	BB5	Carp	A1-CC-3	550	542	0.3
1997	6.54	BB5	White sucker	A1-WS-2	250	176.9	1.1
1997	6.54	BB5	White sucker	A1-WS-1	240	160	1.2
1997	6.54	BB5	Pumpkinseed sunfish	A1-PS-2	120	46.1	2.7
1997	6.54	BB5	Pumpkinseed sunfish	A1-PS-1	130	60.4	2.7
1997	6.54	BB5	Pumpkinseed sunfish	A1-PS-3	90	41.1	5.6

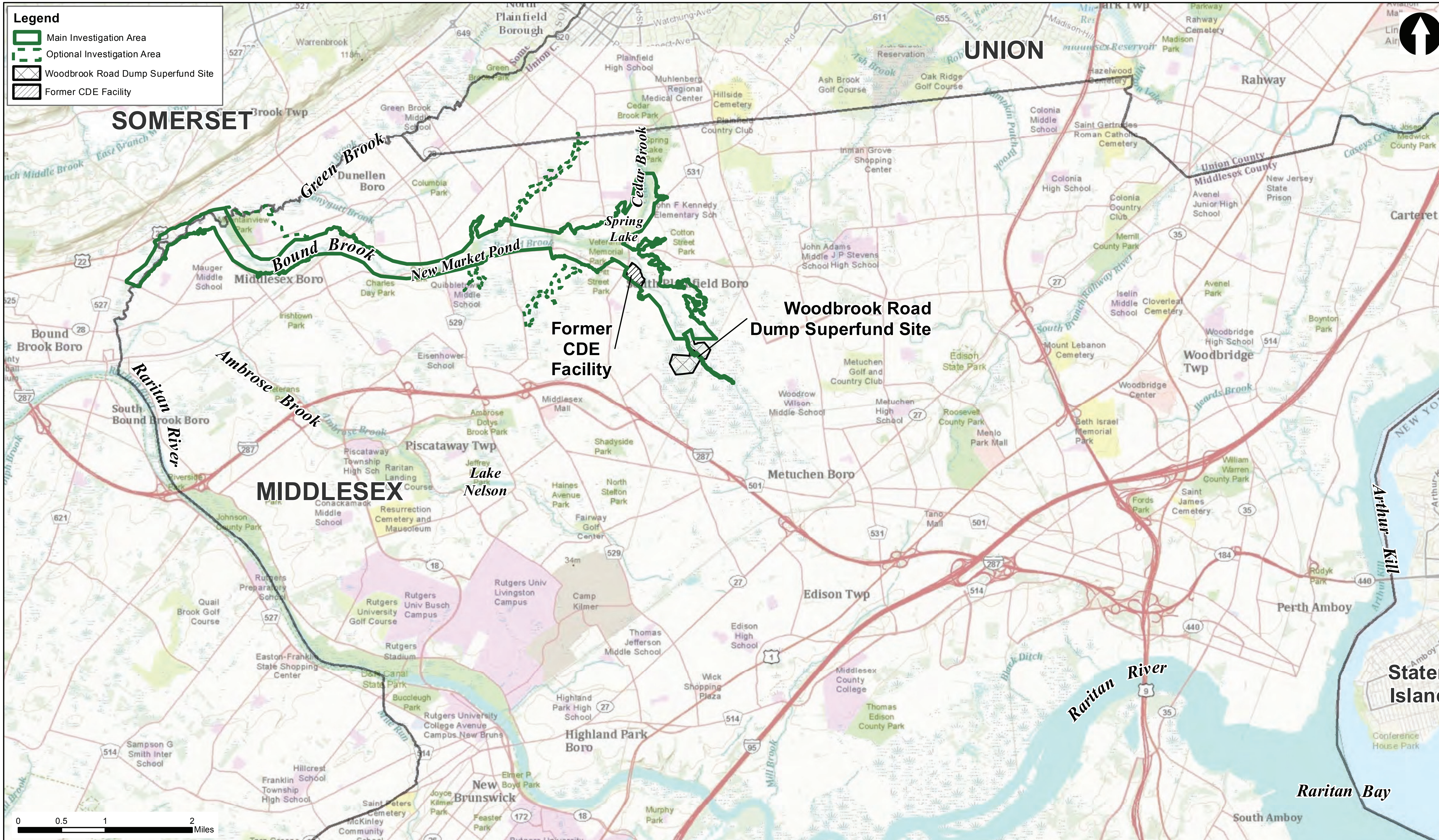
Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	6.98	BB6	White sucker	A9-WS-1	360	505.8	1.1
1997	6.98	BB6	White sucker	A9-WS-2	360	517	1.1
1997	6.98	BB6	White sucker	A9-WS-3	300	326.1	1.2
1997	6.98	BB6	Carp	A9-CC-2	145	49	1.6
1997	6.98	BB6	Carp	A9-CC-3	130	37.5	1.7
1997	6.98	BB6	Carp	A9-CC-1	150	67.6	2.0
2008	7.32	BB6	White sucker	1-WS-6	277	223	1.0
2008	7.32	BB6	White sucker	1-WS-1	151	36.7	1.1
2008	7.32	BB6	White sucker	1-WS-3	219	112	1.1
2008	7.32	BB6	White sucker	1-WS-7	374	559.7	1.1
2008	7.32	BB6	White sucker	1-WS-5	236	145.6	1.1
2008	7.32	BB6	White sucker	1-WS-2	184	69.9	1.1
2008	7.32	BB6	White sucker	1-WS-4	215	113.1	1.1
2008	7.32	BB6	Pumpkinseed sunfish	1-P-4-2	124	38.4	2.0
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-7	90	15.2	2.1
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-1	103	24.1	2.2
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-5	97	20.6	2.3
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-6	91	17.7	2.3
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-3	101	24.2	2.3
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-5	106	28	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-7	101	24.3	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-4	110	32	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-5	98	22.7	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-2	108	30.4	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-3	90	17.7	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-1-4	136	61.2	2.4
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-4	102	26.3	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-8	102	26.4	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-7	114	37	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-4-1	133	59.6	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-2	90	18.5	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-1-2	156	96.6	2.5
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-2	106	30.4	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-1	118	42.1	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-6	96	22.7	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-4-3	120	44.5	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-3-6	108	32.5	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-4	114	38.8	2.6
2008	7.32	BB6	Pumpkinseed sunfish	1-P-2-3	113	38.3	2.7
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-8	79	13.1	2.7
2008	7.32	BB6	Pumpkinseed sunfish	1-P-5-1	107	33	2.7
2008	7.32	BB6	Pumpkinseed sunfish	1-P-1-5	134	64.9	2.7
2008	7.32	BB6	Pumpkinseed sunfish	1-P-4-4	123	54.1	2.9
2008	7.32	BB6	Pumpkinseed sunfish	1-P-1-3	147	94.6	3.0
2008	7.32	BB6	Pumpkinseed sunfish	1-P-1-1	152	116.1	3.3

Table 6-2: Summary of Fish Condition Factors
Cornell-Dubilier Electronics Superfund Site: OU4 Bound Brook

Investigation	River Mile	Exposure Unit	Fish Species	Fish ID	Length (mm)	Mass (g)	Fish Condition Factor
1997	SL	SL	White sucker	WS-A10-3	325	348.6	1.0
1997	SL	SL	White sucker	WS-A10-2	370	525	1.0
2008	SL	SL	White sucker	7-WS-3	355	526.3	1.2
2008	SL	SL	White sucker	7-WS-2	340	469.6	1.2
2008	SL	SL	White sucker	7-WS-1	380	657.7	1.2
1997	SL	SL	White sucker	WS-A10-1	355	549.8	1.2
2008	SL	SL	Carp	7-C-5	530	2004.4	1.3
1997	SL	SL	Carp	CC-A10-2	470	1405.7	1.4
2008	SL	SL	Carp	7-C-2	625	3431.4	1.4
2008	SL	SL	Carp	7-C-4	570	2715.4	1.5
1997	SL	SL	Carp	CC-A10-3	450	1336.8	1.5
2008	SL	SL	Carp	7-C-7	585	2942.4	1.5
2008	SL	SL	Carp	7-C-3	550	2464.4	1.5
2008	SL	SL	Carp	7-C-8	570	2744.4	1.5
1997	SL	SL	Largemouth bass	BS-A10-2	330	572.3	1.6
1997	SL	SL	Carp	CC-A10-1	440	1415	1.7
2008	SL	SL	Carp	7-C-1	665	5070.4	1.7
1997	SL	SL	Largemouth bass	BS-A10-1	415	1260.2	1.8
2008	SL	SL	Carp	7-C-6	580	3512.4	1.8
2008	SL	SL	Bluegill sunfish	7-BG-2-1	160	76.1	1.9
2008	SL	SL	Bluegill sunfish	7-BG-1-4	165	84.1	1.9
1997	SL	SL	Pumpkinseed sunfish	PS-A10-2-B	100	18.8	1.9
2008	SL	SL	Bluegill sunfish	7-BG-2-3	142	54.2	1.9
2008	SL	SL	Bluegill sunfish	7-BG-4-3	155	70.9	1.9
2008	SL	SL	Bluegill sunfish	7-BG-3-1	140	52.9	1.9
2008	SL	SL	Bluegill sunfish	7-BG-5-2	155	72.4	1.9
1997	SL	SL	Pumpkinseed sunfish	PS-A10-2-C	105	22.6	2.0
1997	SL	SL	Pumpkinseed sunfish	PS-A10-1-E	90	14.3	2.0
2008	SL	SL	Bluegill sunfish	7-BG-3-4	134	47.2	2.0
1997	SL	SL	Pumpkinseed sunfish	PS-A10-2-E	95	16.9	2.0
1997	SL	SL	Pumpkinseed sunfish	PS-A10-1-B	105	22.9	2.0
2008	SL	SL	Bluegill sunfish	7-BG-4-4	135	48.7	2.0
2008	SL	SL	Bluegill sunfish	7-BG-3-5	126	39.7	2.0
1997	SL	SL	Pumpkinseed sunfish	PS-A10-1-A	125	38.9	2.0
2008	SL	SL	Bluegill sunfish	7-BG-4-2	135	49.2	2.0
1997	SL	SL	Pumpkinseed sunfish	PS-A10-2-D	100	20.2	2.0
2008	SL	SL	Bluegill sunfish	7-BG-2-2	145	61.7	2.0
2008	SL	SL	Bluegill sunfish	7-BG-3-2	136	53.3	2.1
2008	SL	SL	Bluegill sunfish	7-BG-3-3	130	46.7	2.1
2008	SL	SL	Bluegill sunfish	7-BG-5-1	160	87.7	2.1
2008	SL	SL	Bluegill sunfish	7-BG-1-1	170	105.8	2.2
2008	SL	SL	Bluegill sunfish	7-BG-2-4	136	54.4	2.2
2008	SL	SL	Bluegill sunfish	7-BG-4-5	126	43.7	2.2
2008	SL	SL	Bluegill sunfish	7-BG-1-2	170	107.7	2.2
1997	SL	SL	Pumpkinseed sunfish	PS-A10-1-D	100	22	2.2
1997	SL	SL	Pumpkinseed sunfish	PS-A10-2-A	110	29.3	2.2
2008	SL	SL	Bluegill sunfish	7-BG-1-5	155	82.2	2.2
2008	SL	SL	Bluegill sunfish	7-BG-4-1	131	50.3	2.2
2008	SL	SL	Bluegill sunfish	7-BG-5-4	155	83.6	2.2
2008	SL	SL	Bluegill sunfish	7-BG-5-5	150	75.8	2.2
2008	SL	SL	Bluegill sunfish	7-BG-2-5	140	61.9	2.3
1997	SL	SL	Pumpkinseed sunfish	PS-A10-1-C	90	17	2.3
2008	SL	SL	Bluegill sunfish	7-BG-1-3	165	108.2	2.4
2008	SL	SL	Bluegill sunfish	7-BG-5-3	136	62.3	2.5
1997	SL	SL	Largemouth bass	BS-A10-3	180	843.3	14.5

FIGURES



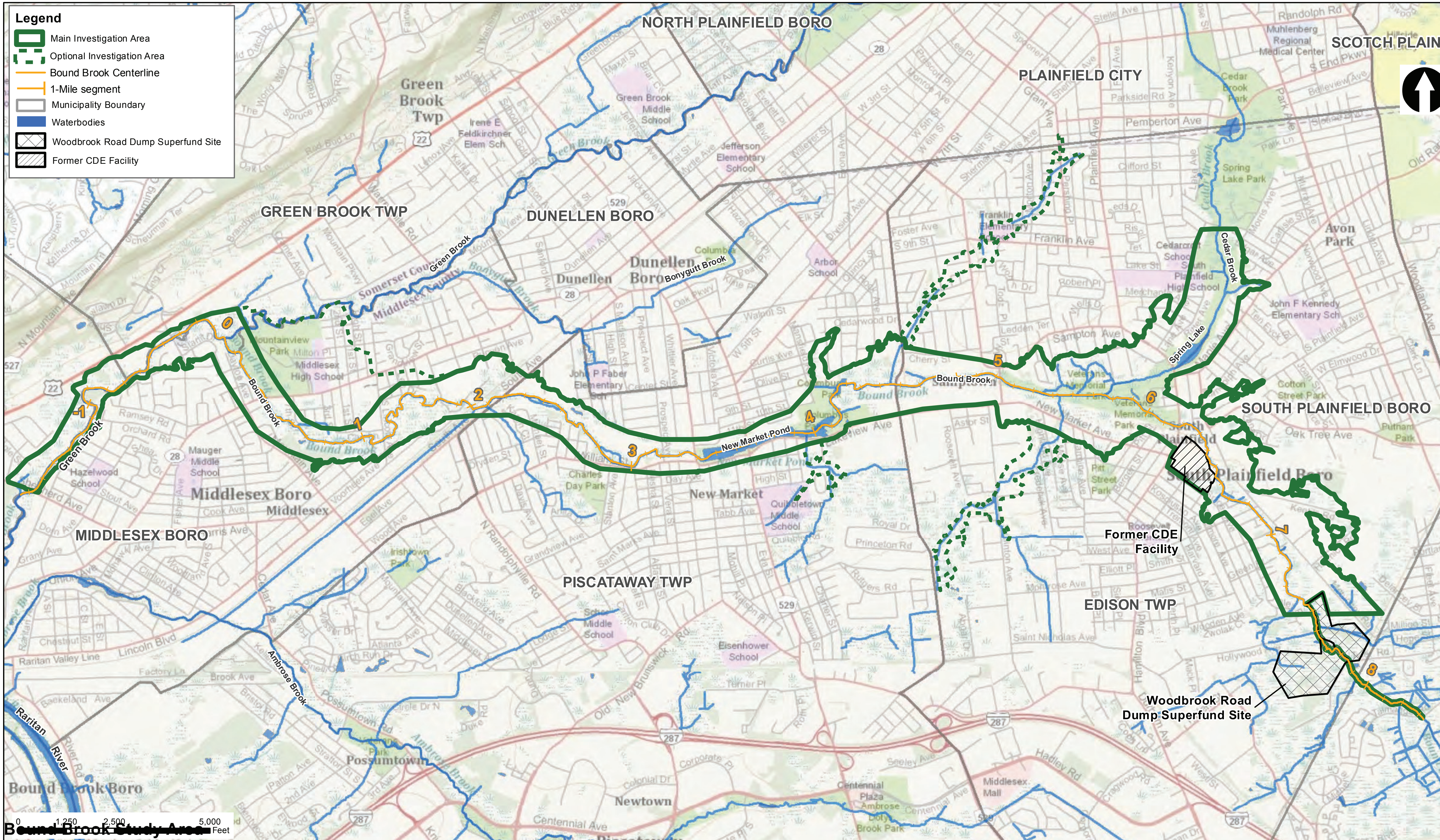
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

OU4 Bound Brook Regional Location Map

Bound Brook OU4 RI/FS

2014

Figure 1-1

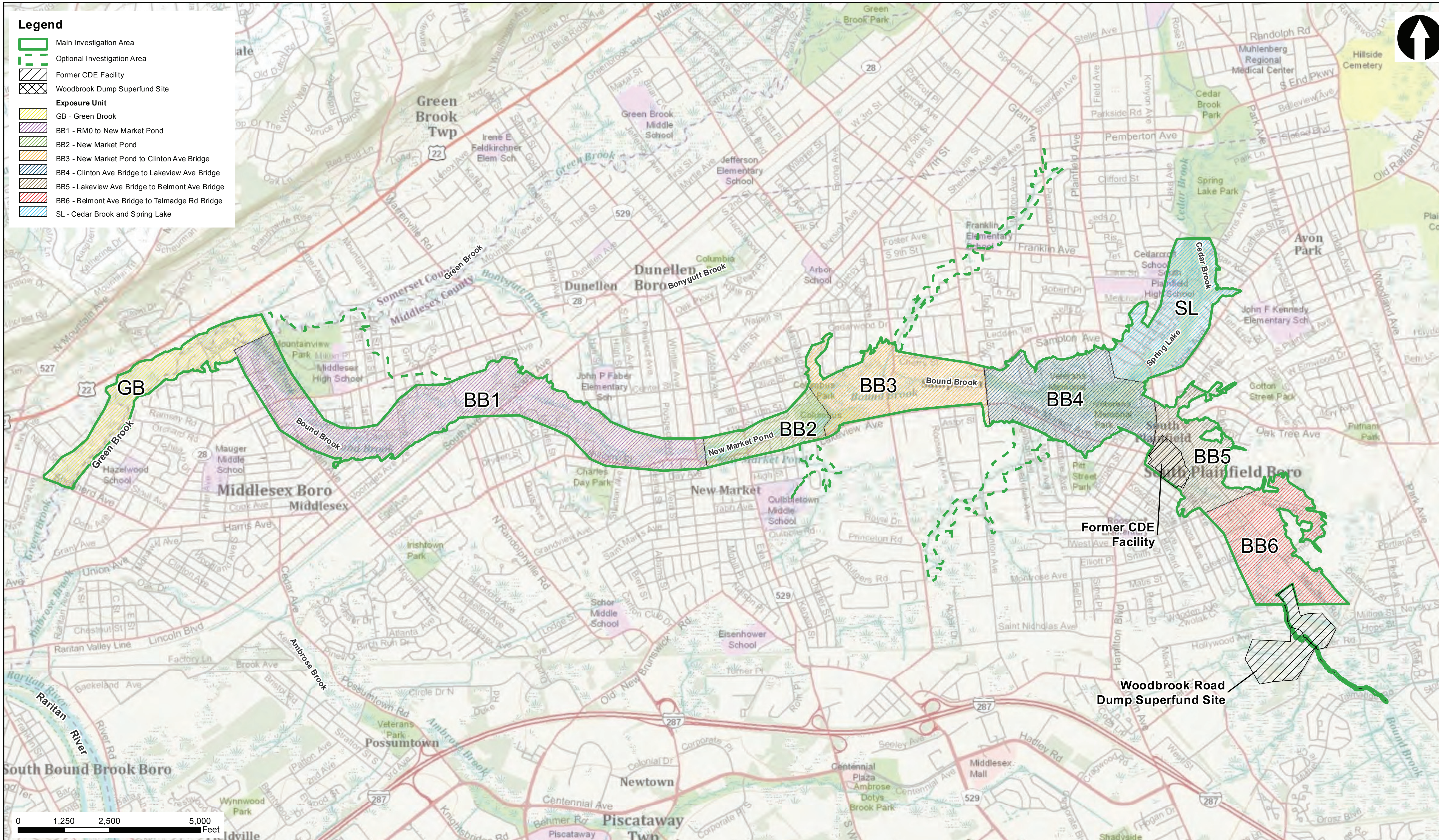


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

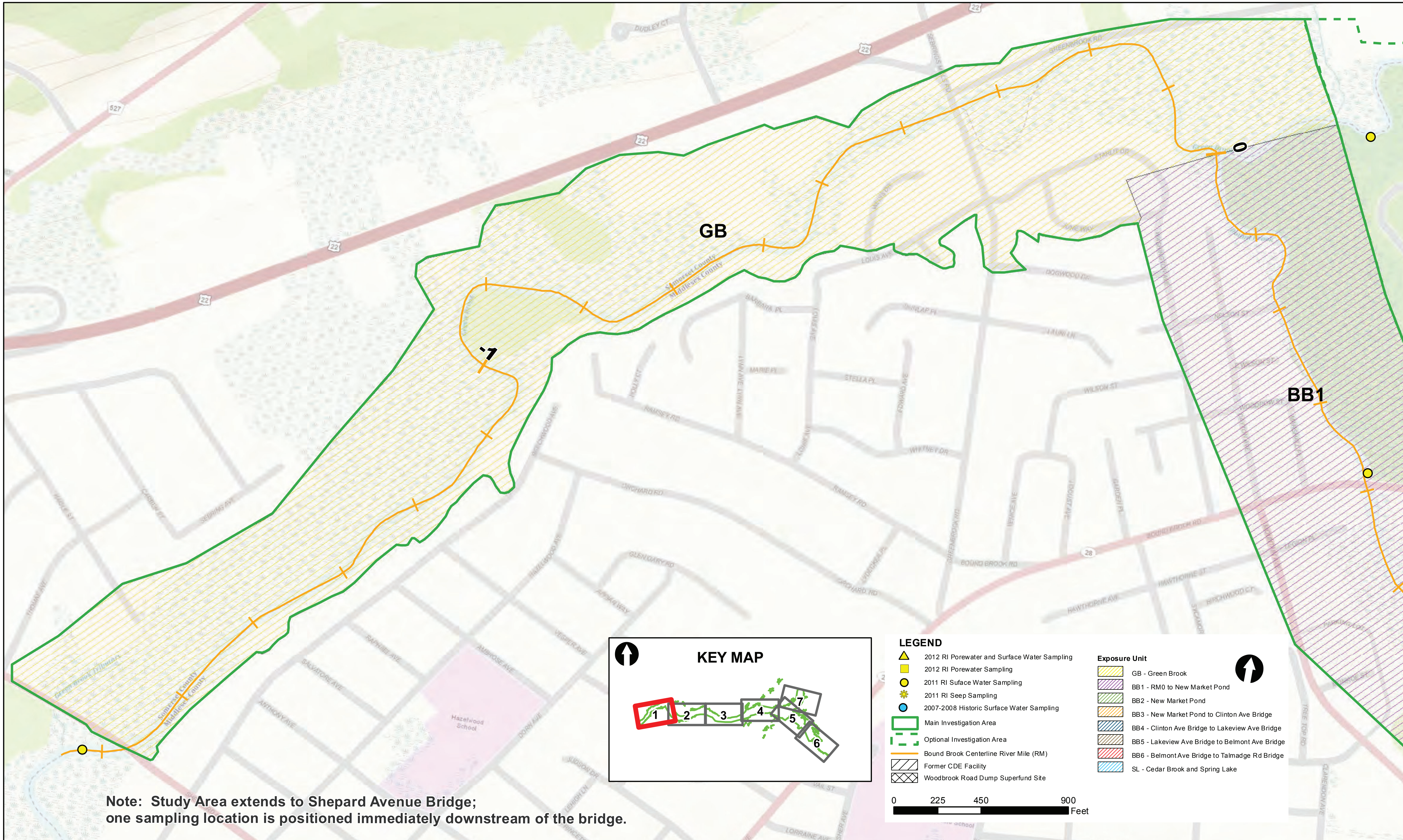
Bound Brook OU4 RI/FS

2014

Figure 1-2



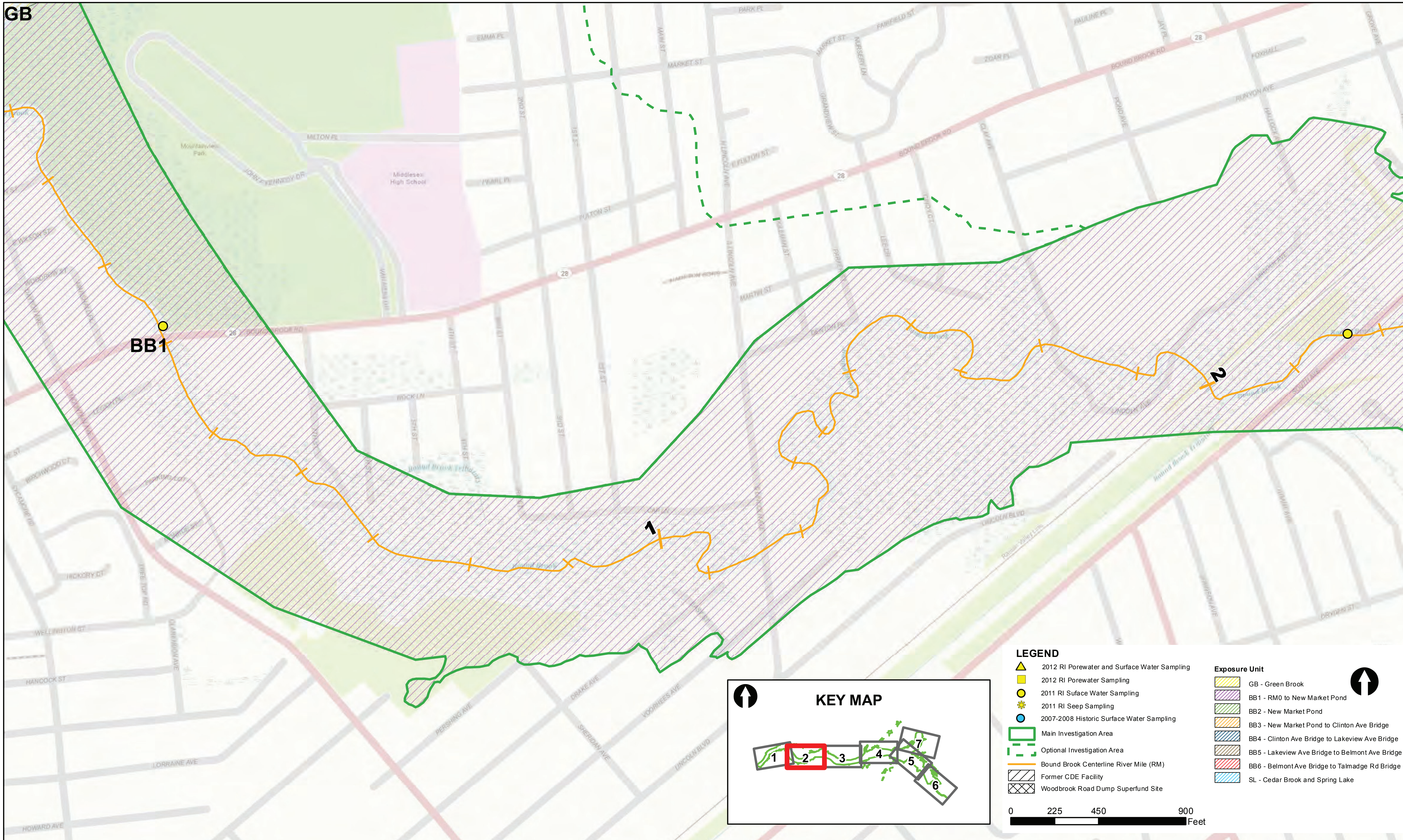
Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	**Exposure Units for the OU4 Risk Assessment** *Bound Brook OU4 RI/FS*	2014 Figure 2-1



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations
Bound Brook OU4 RI/FS

2014
Figure 2-2
Sheet 1 of 7



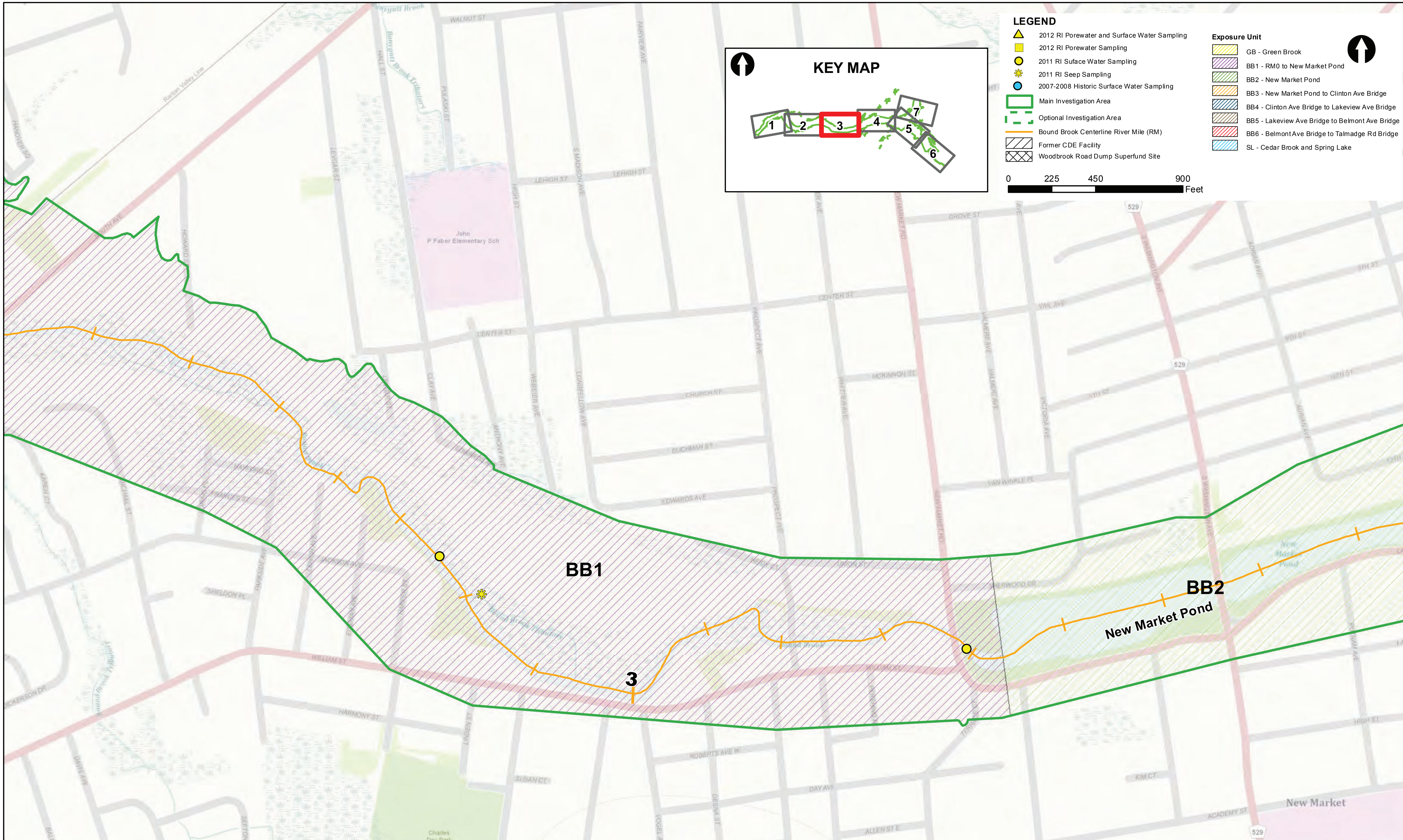
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-2
Sheet 2 of 7



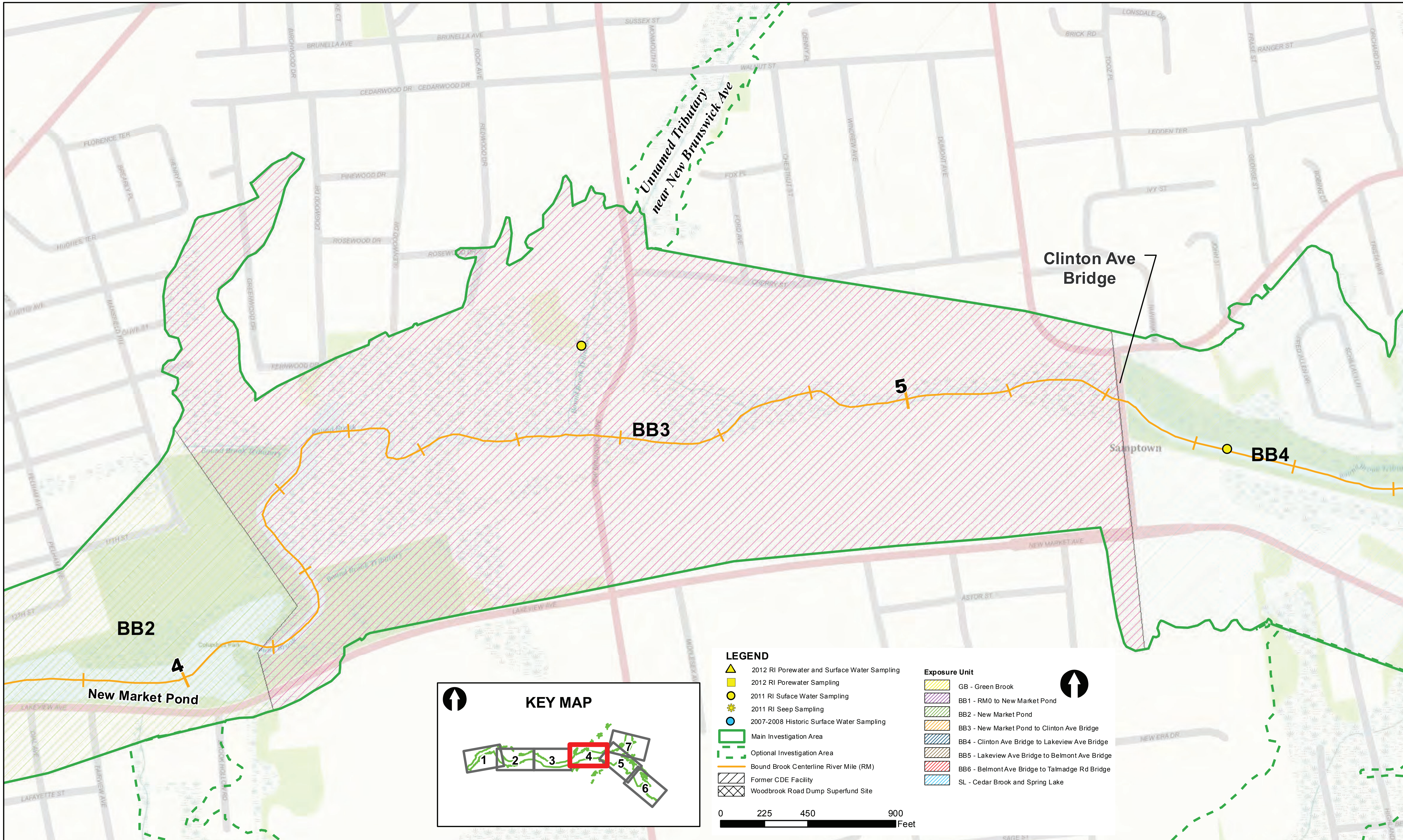
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-2
Sheet 3 of 7



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

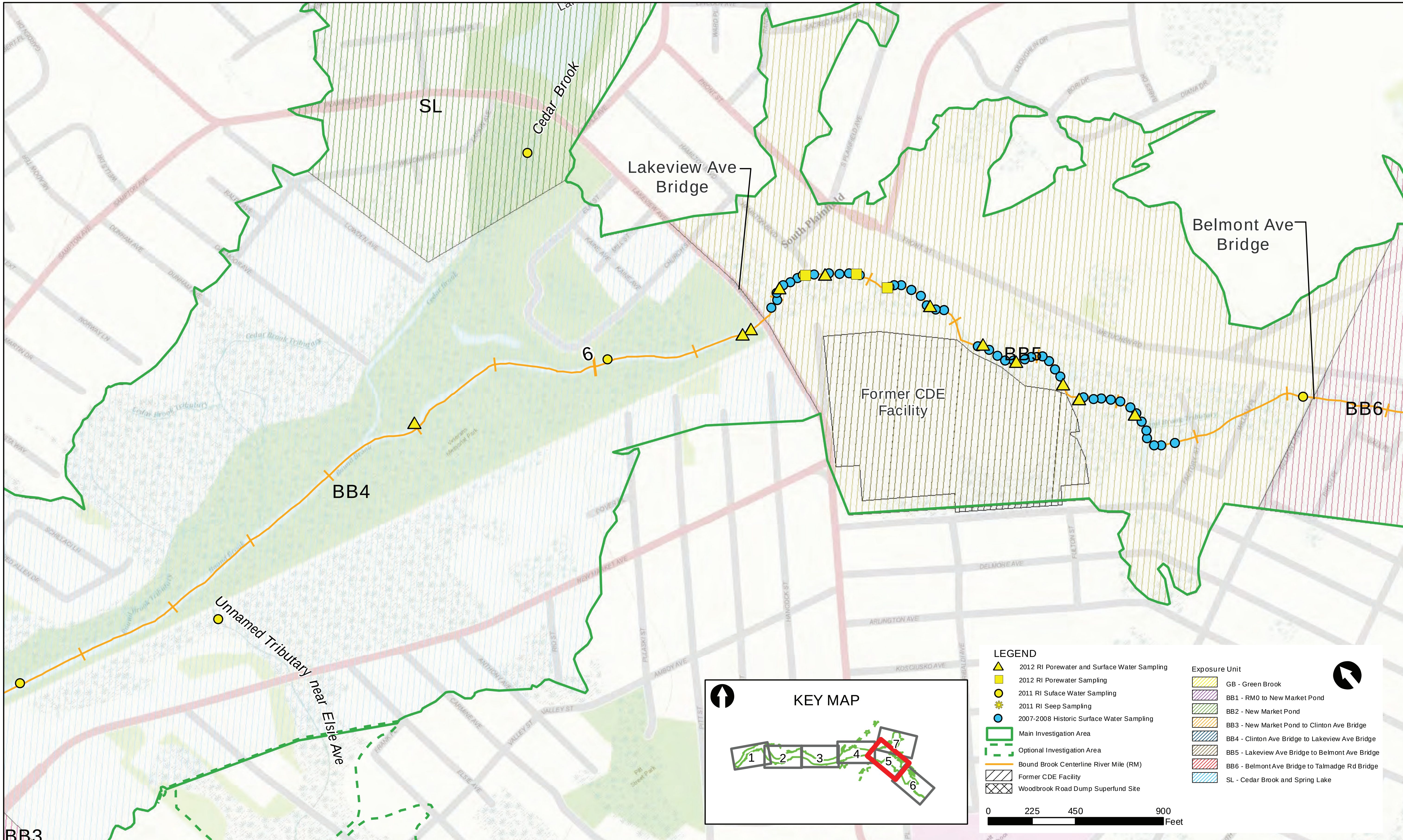
Exposure Unit Boundaries with Historical and Current Surface Water and Porewater Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-2

Sheet 4 of 7



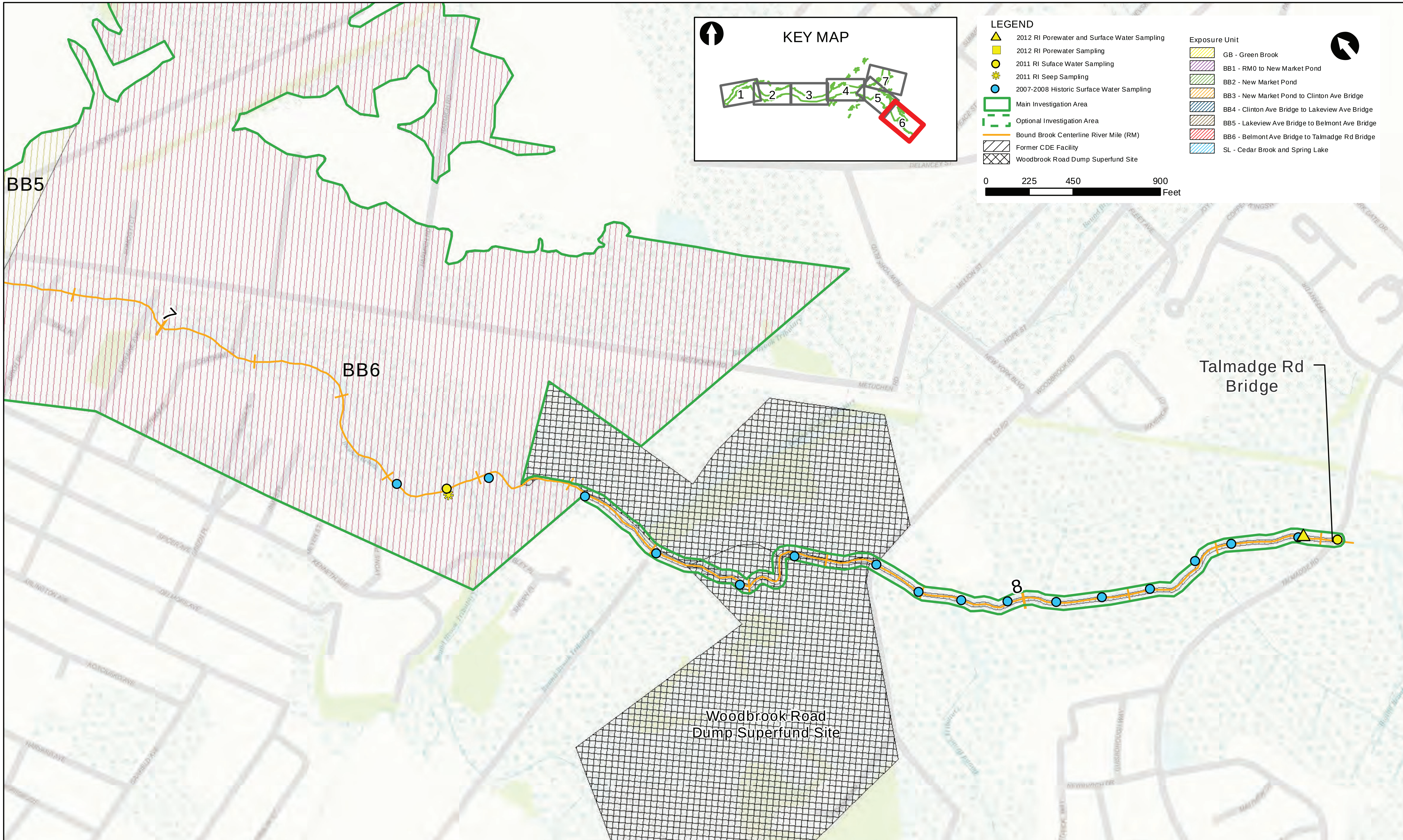
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-2
Sheet 5 of 7



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

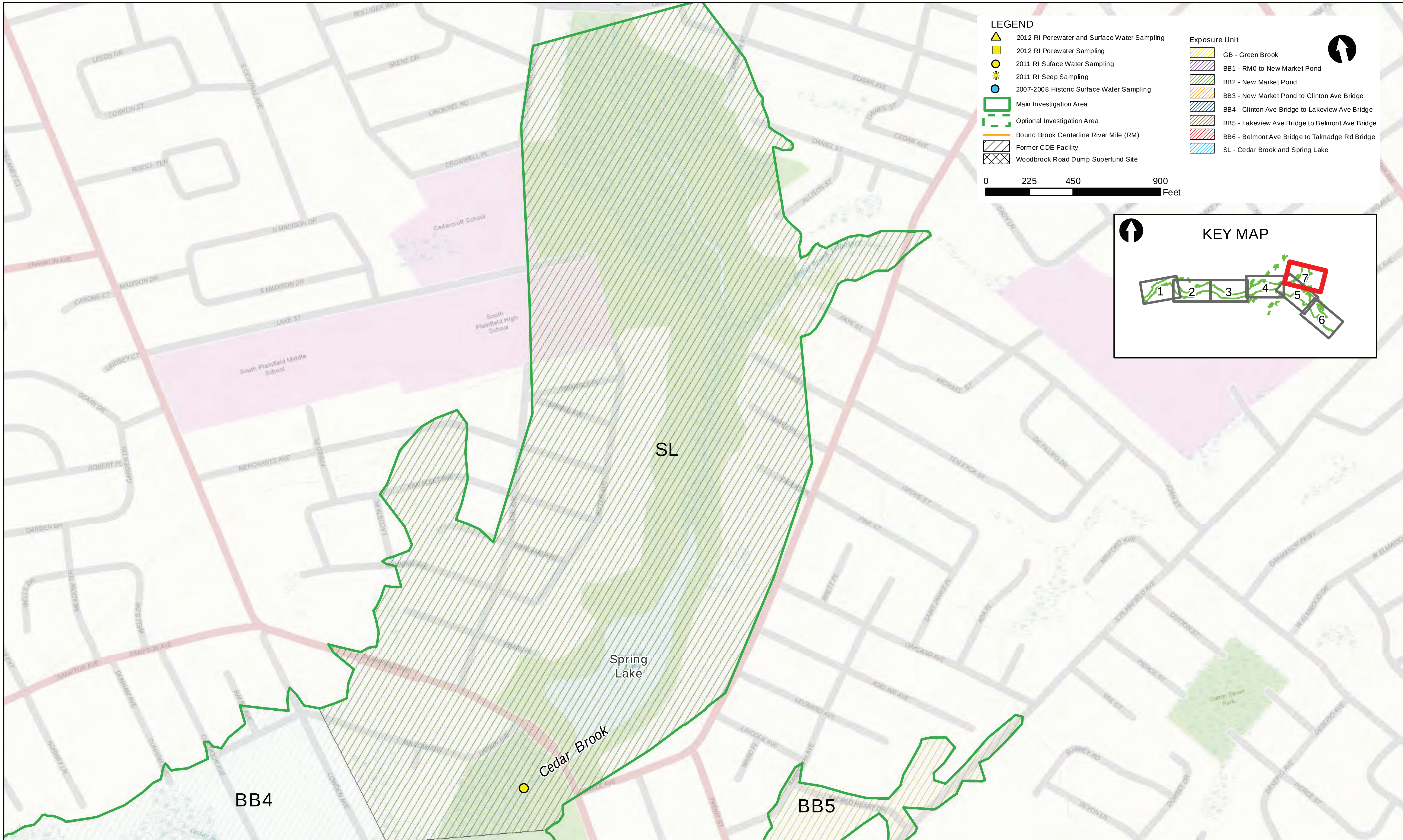
Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-2

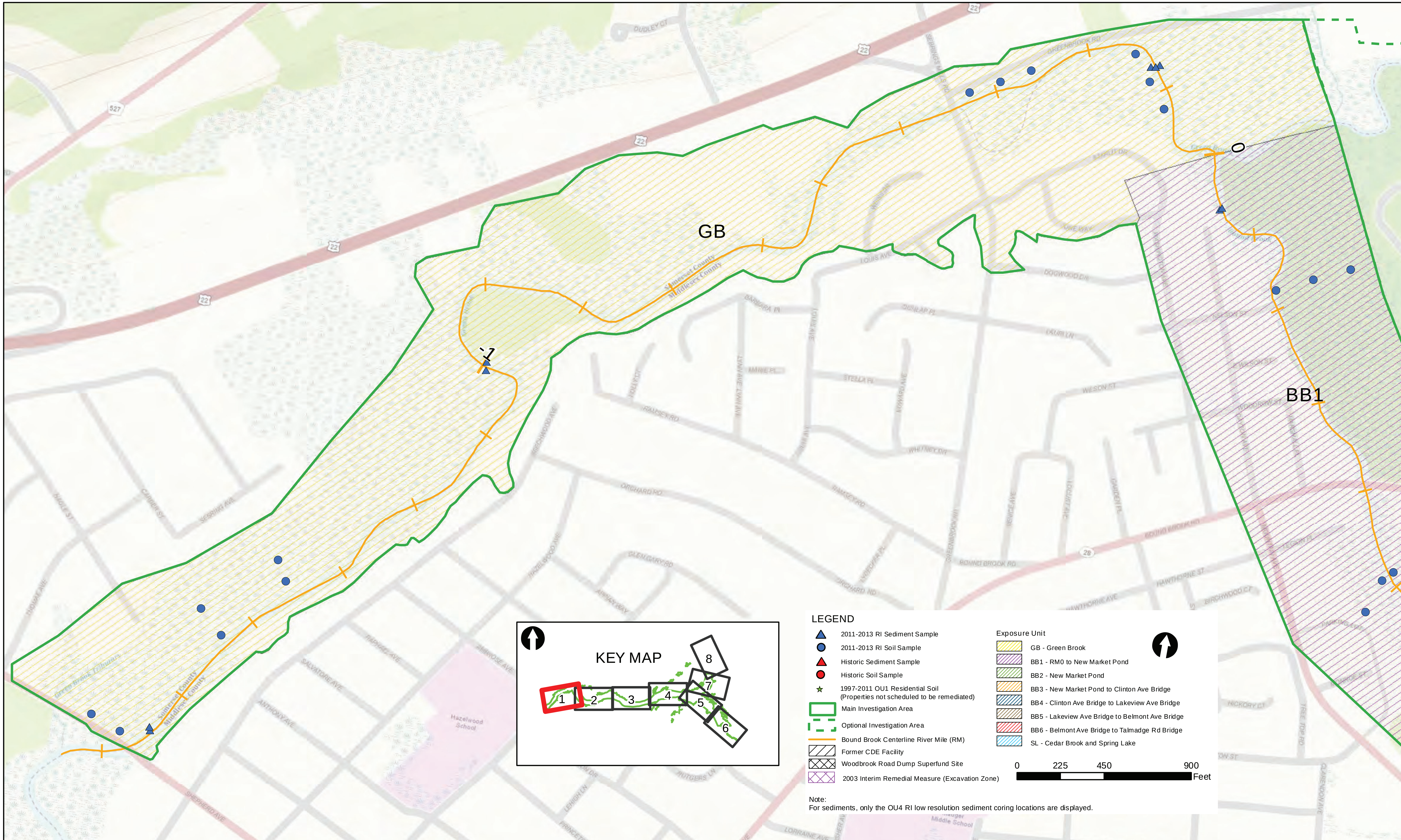
Sheet 6 of 7



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Surface Water and Porewater Sampling Locations
Bound Brook OU4 RI/FS

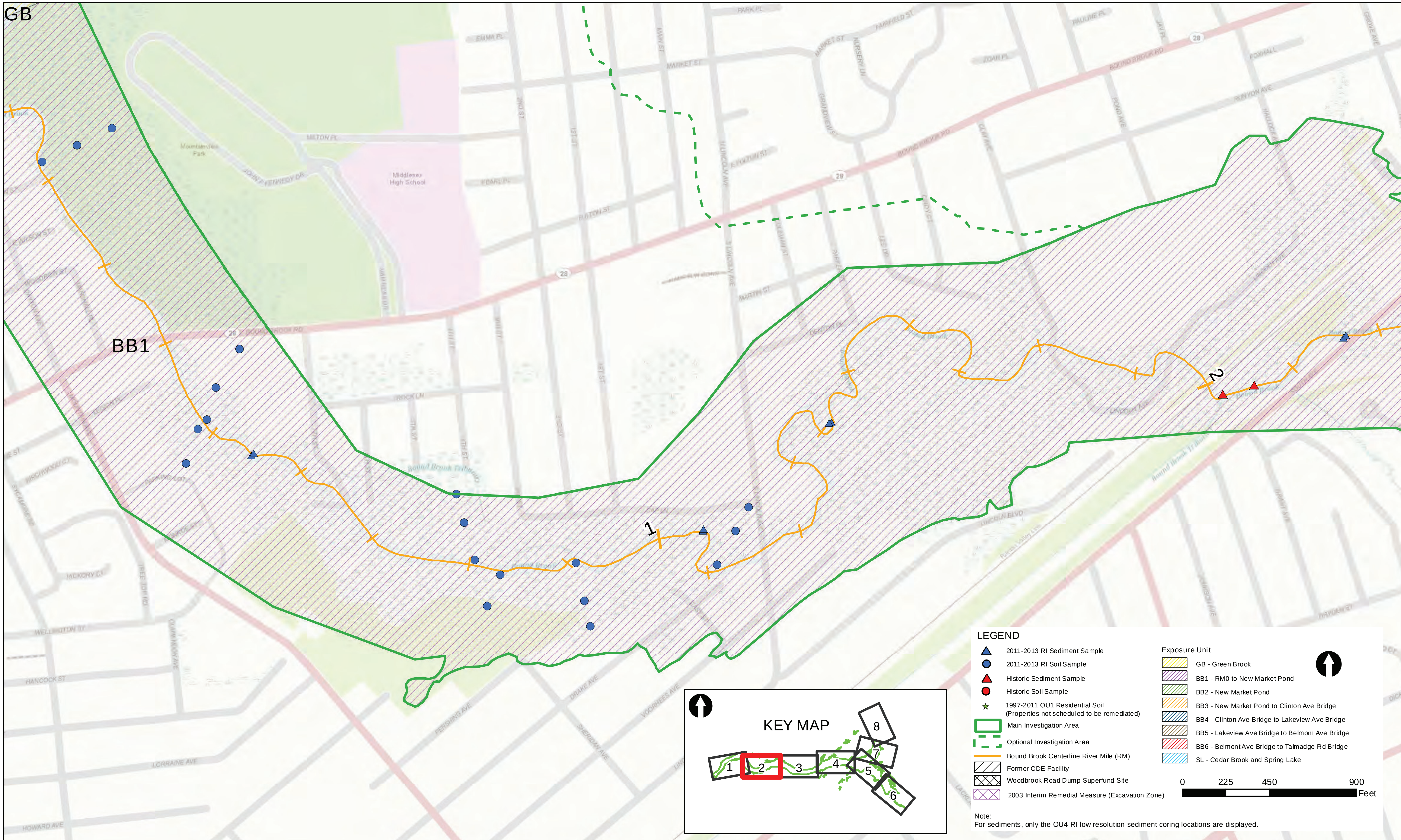
2014
Figure 2-2
Sheet 7 of 7



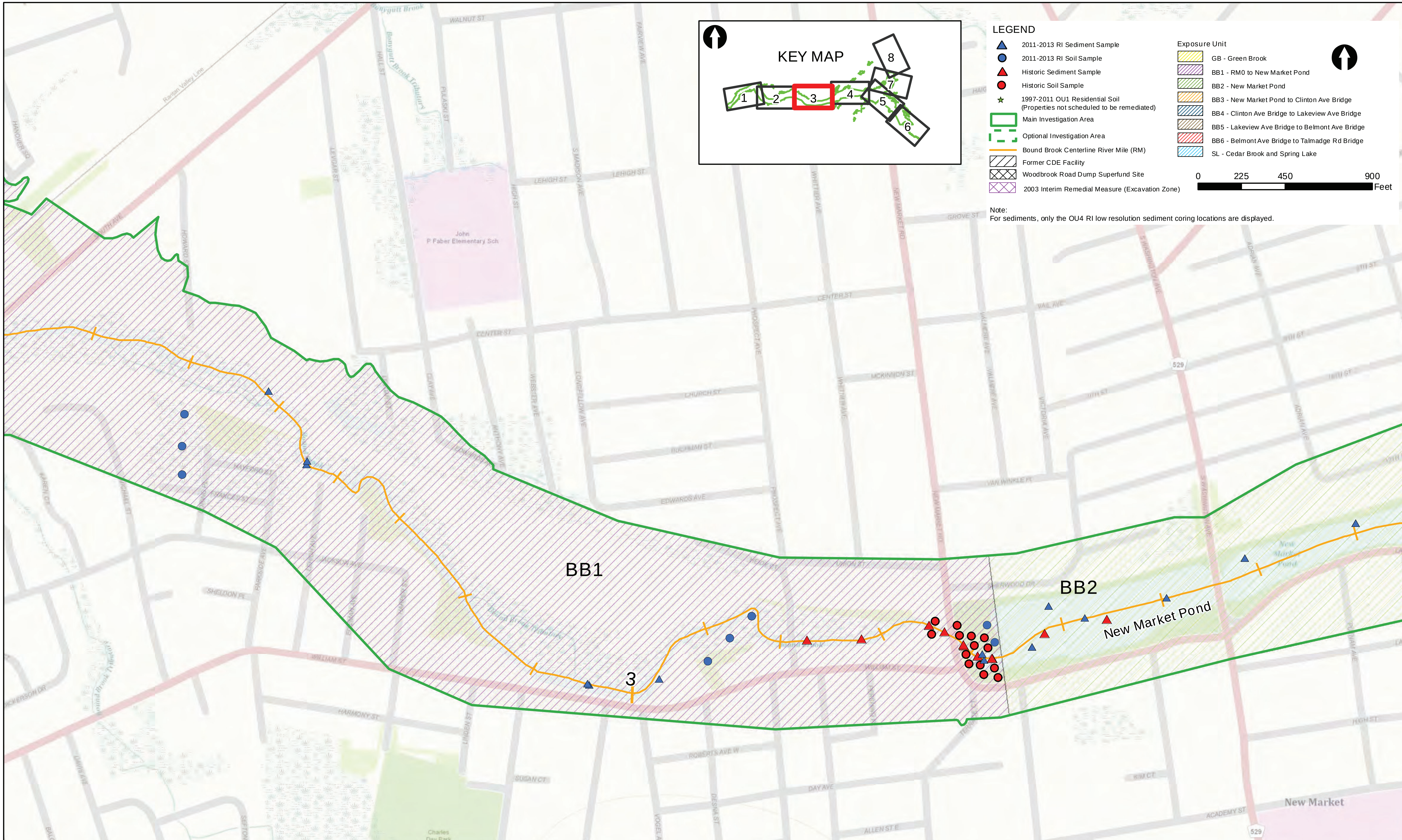
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries
with Historical and Current Sediment and Soil Sampling Locations
Bound Brook OU4 RI/FS

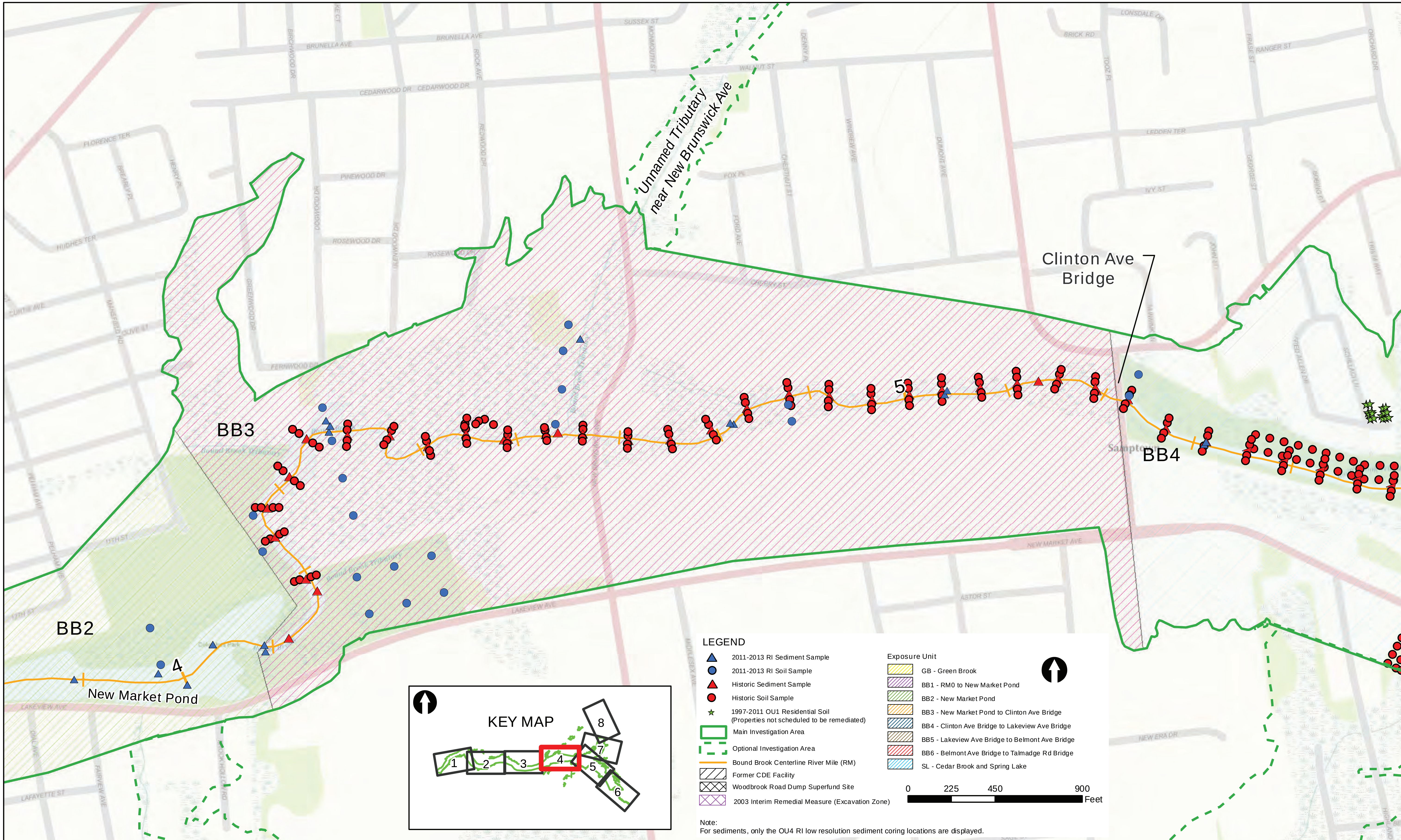
2014
Figure 2-3
Sheet 1 of 8



	Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	Exposure Unit Boundaries with Historical and Current Sediment and Soil Sampling Locations *Bound Brook OU4 RI/FS*	2014 Figure 2-3 Sheet 2 of 8



	Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	Exposure Unit Boundaries with Historical and Current Sediment and Soil Sampling Locations *Bound Brook OU4 RI/FS*	2014 Figure 2-3 Sheet 3 of 8

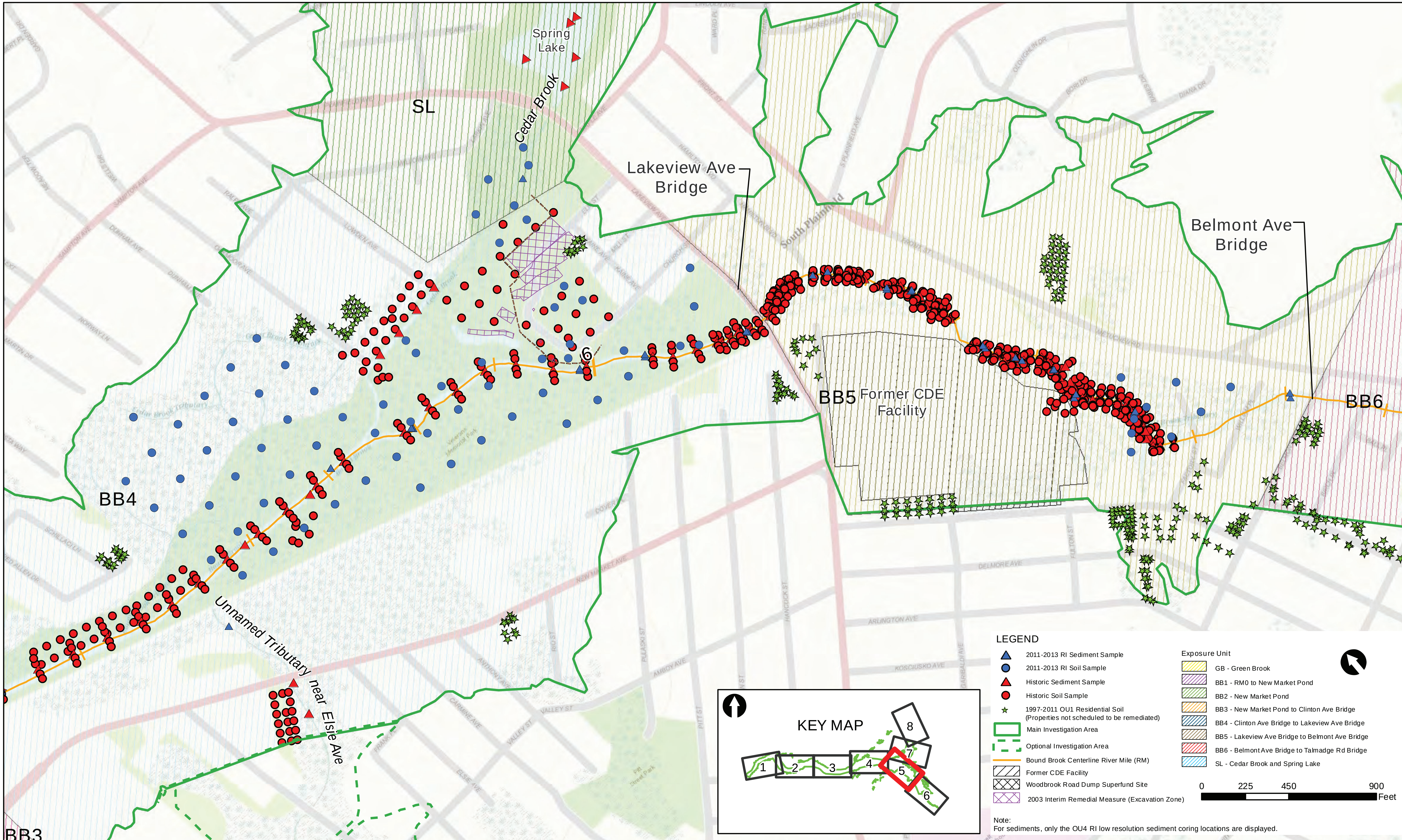


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries
with Historical and Current Sediment and Soil Sampling Locations
Bound Brook OU4 RI/FS

2014

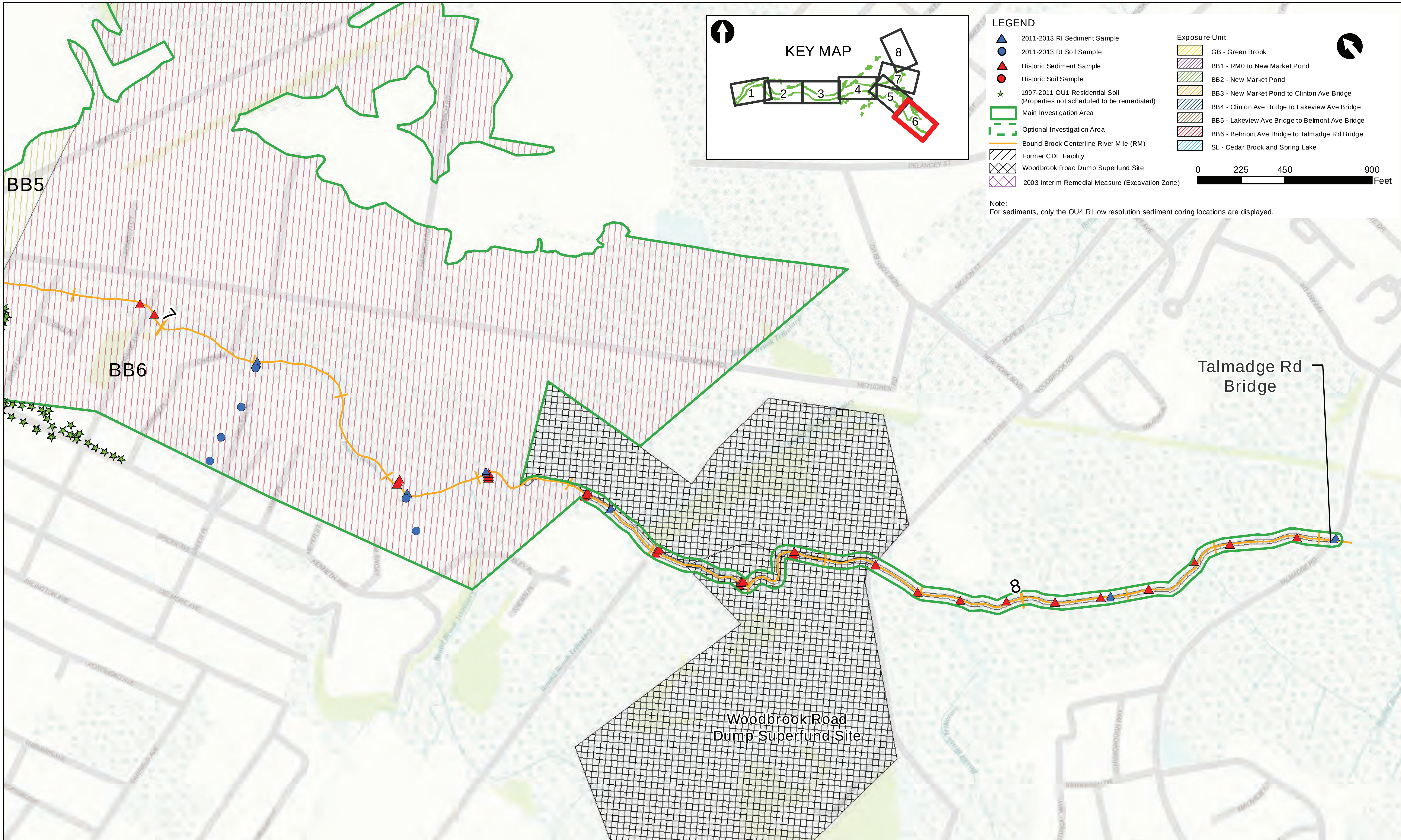
Figure 2-3
Sheet 4 of 8



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries
with Historical and Current Sediment and Soil Sampling Locations
Bound Brook OU4 RI/FS

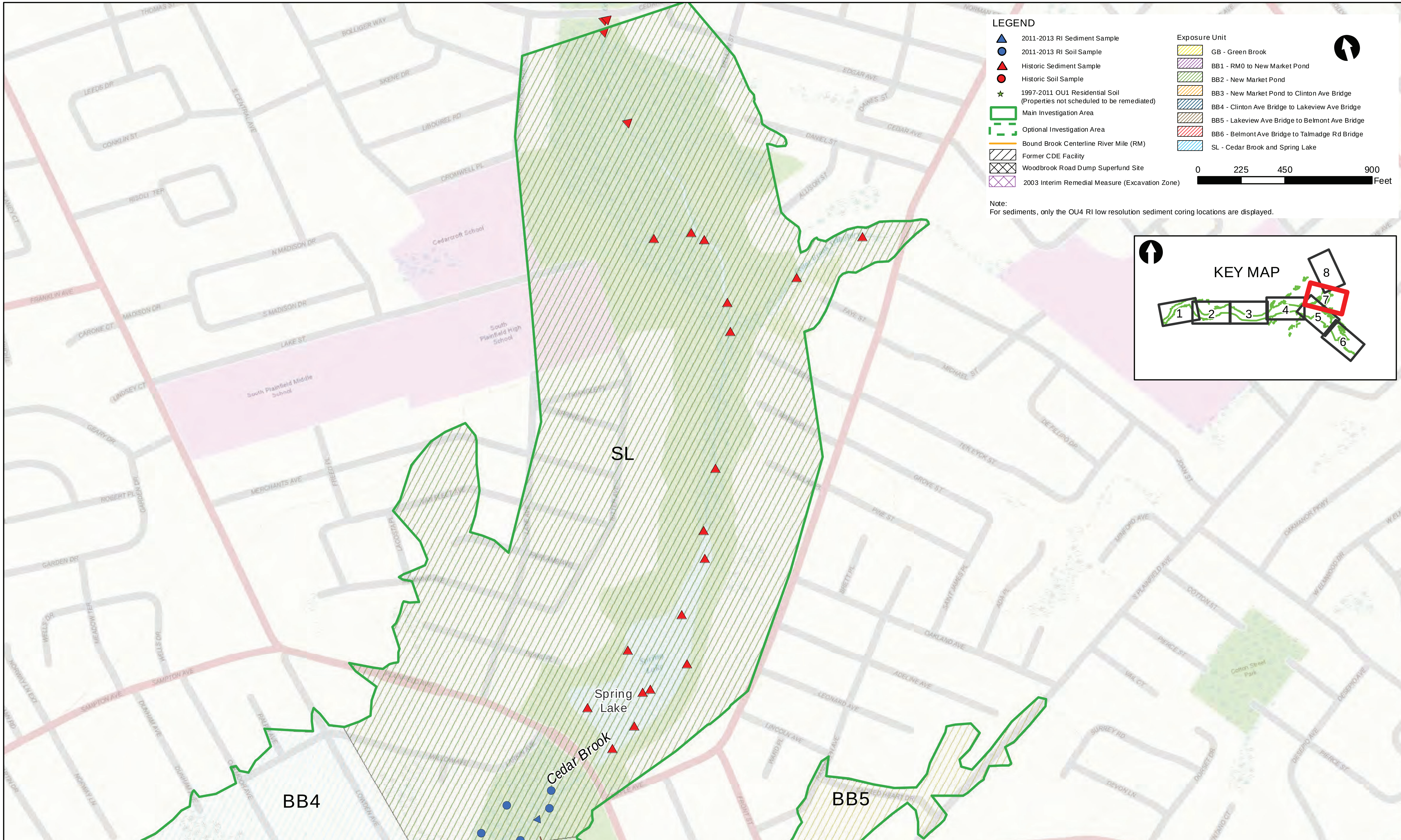
2014
Figure 2-3
Sheet 5 of 8



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries
with Historical and Current Sediment and Soil Sampling Locations
Bound Brook OU4 RI/FS

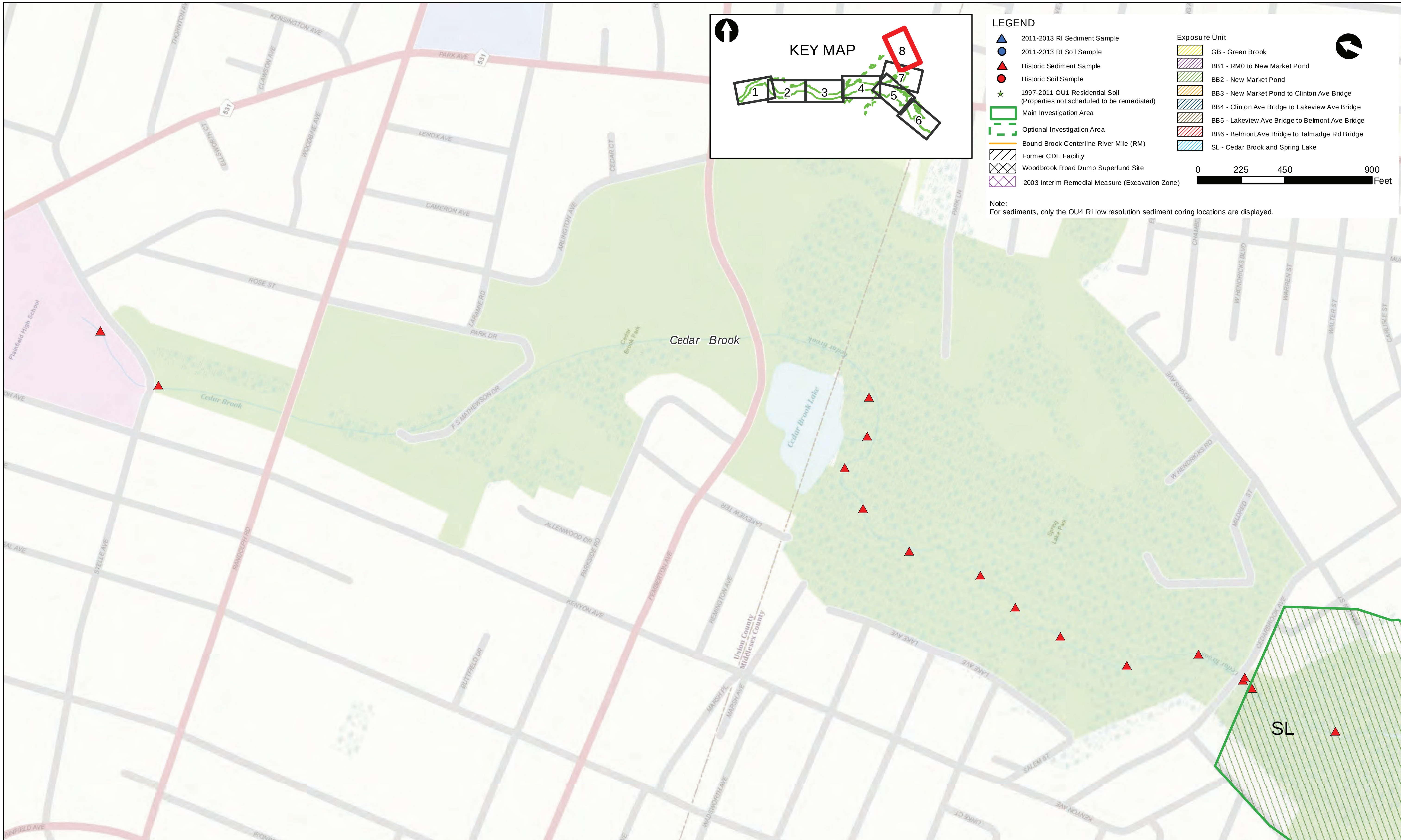
2014
Figure 2-3
Sheet 6 of 8



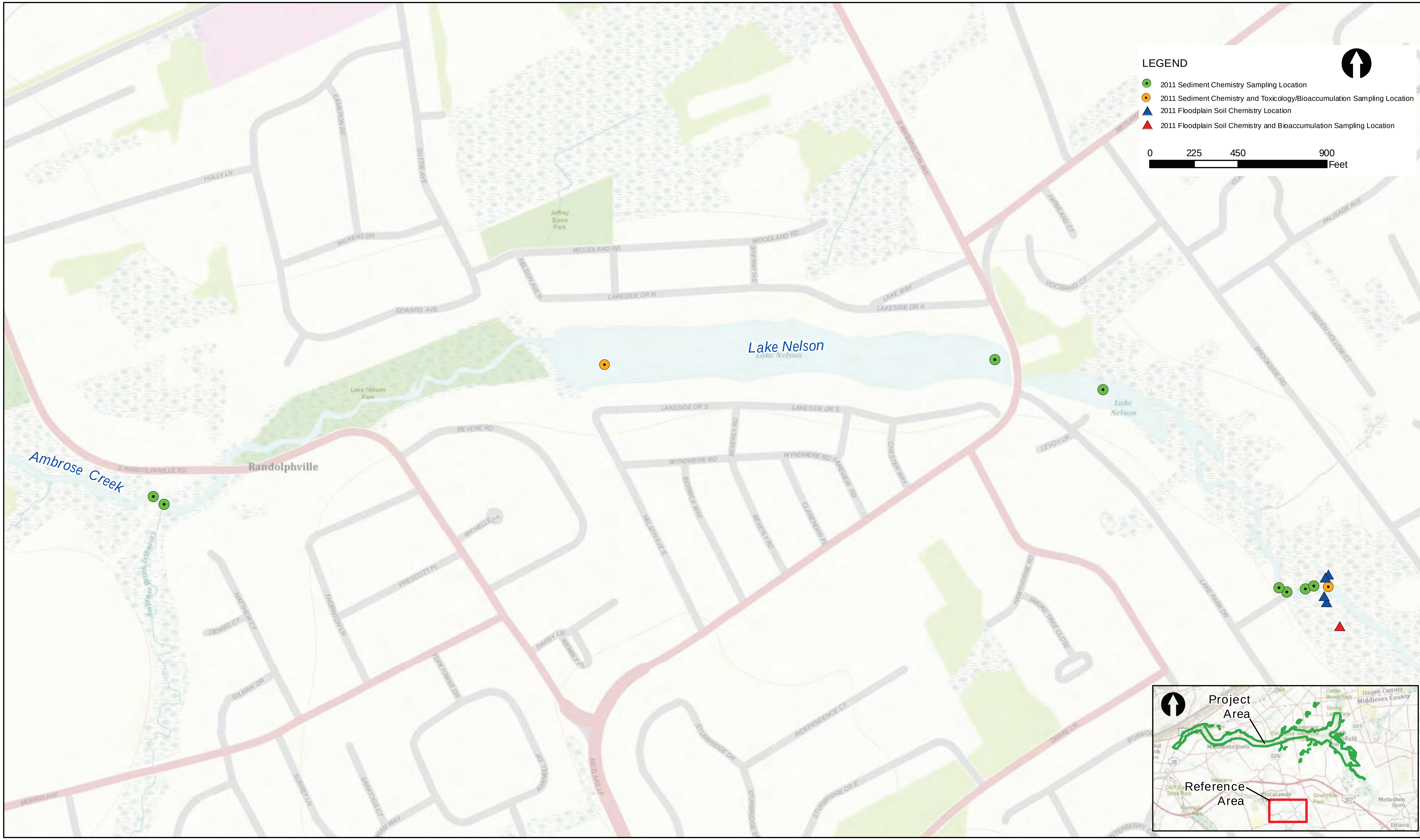
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries
with Historical and Current Sediment and Soil Sampling Locations
Bound Brook OU4 RI/FS

2014
Figure 2-3
Sheet 7 of 8



	Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	Exposure Unit Boundaries with Historical and Current Sediment and Soil Sampling Locations *Bound Brook OU4 RI/FS*	2014 Figure 2-3 Sheet 8 of 8

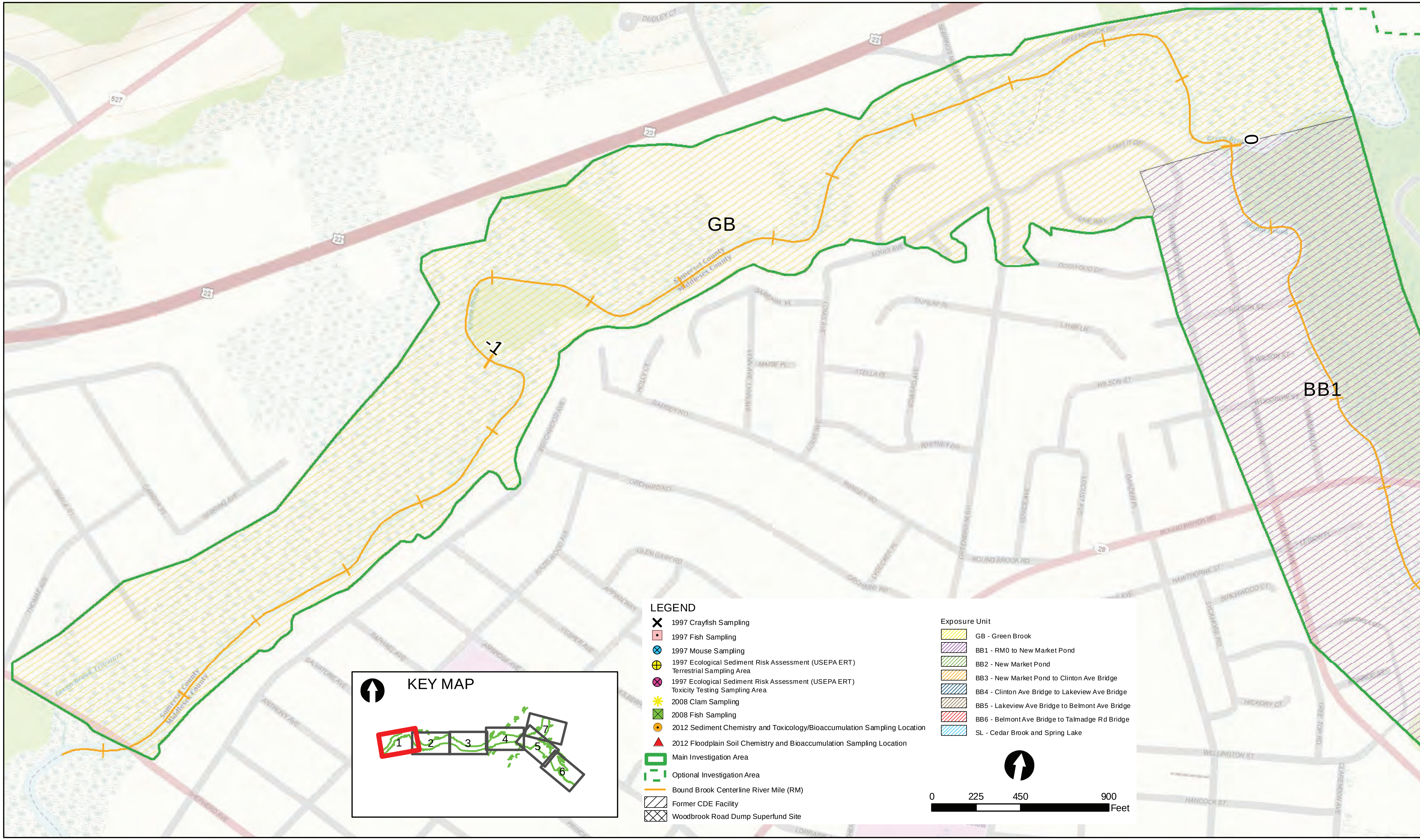


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Reference Area Sampling Locations
Bound Brook OU4 RI/FS

2014

Figure 2-4



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

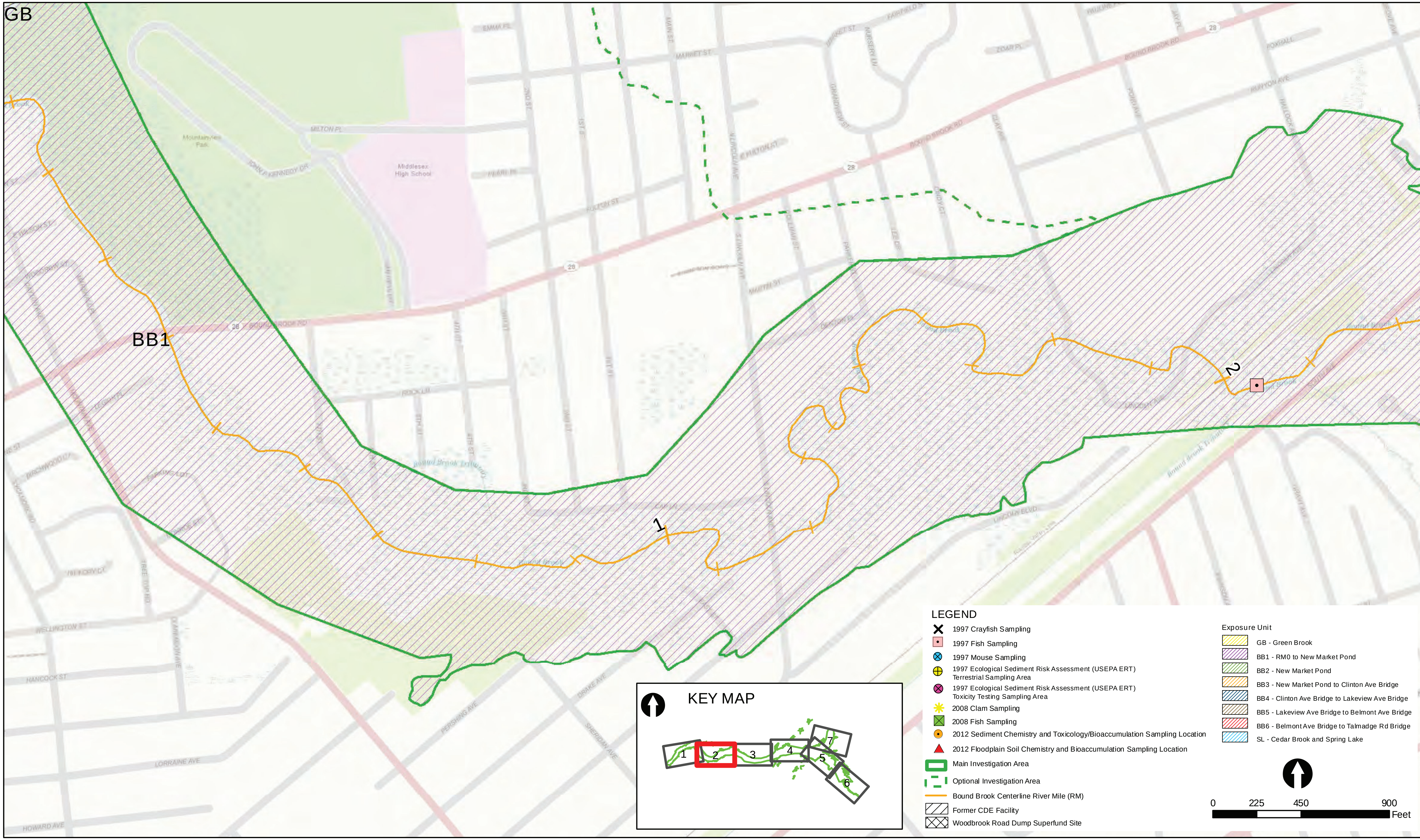
Exposure Unit Boundaries with
Historical and Current Biota and Toxicity Testing Sampling Locations

Bound Brook OU4 RI/FS

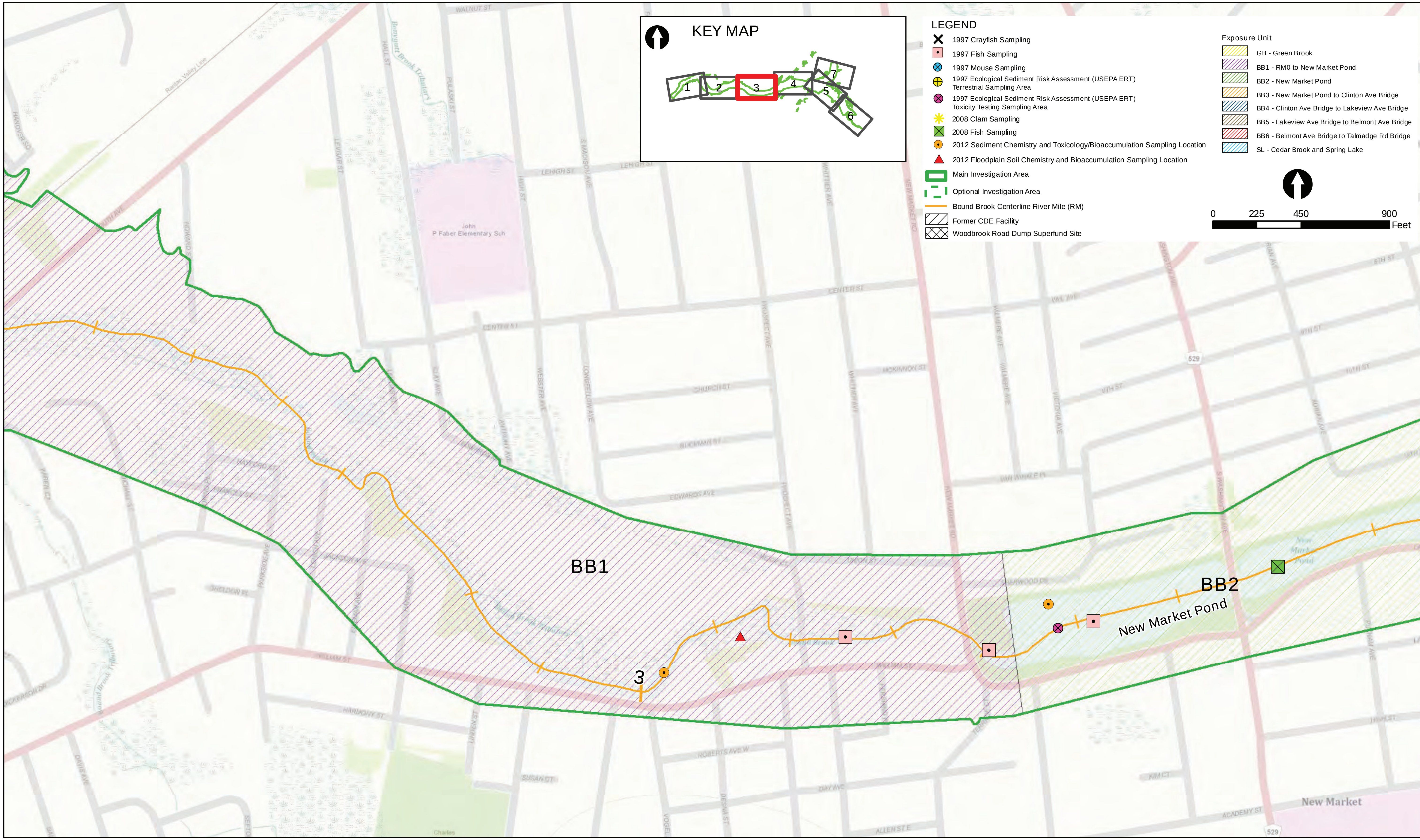
2014

Figure 2-5

Sheet 1 of 7



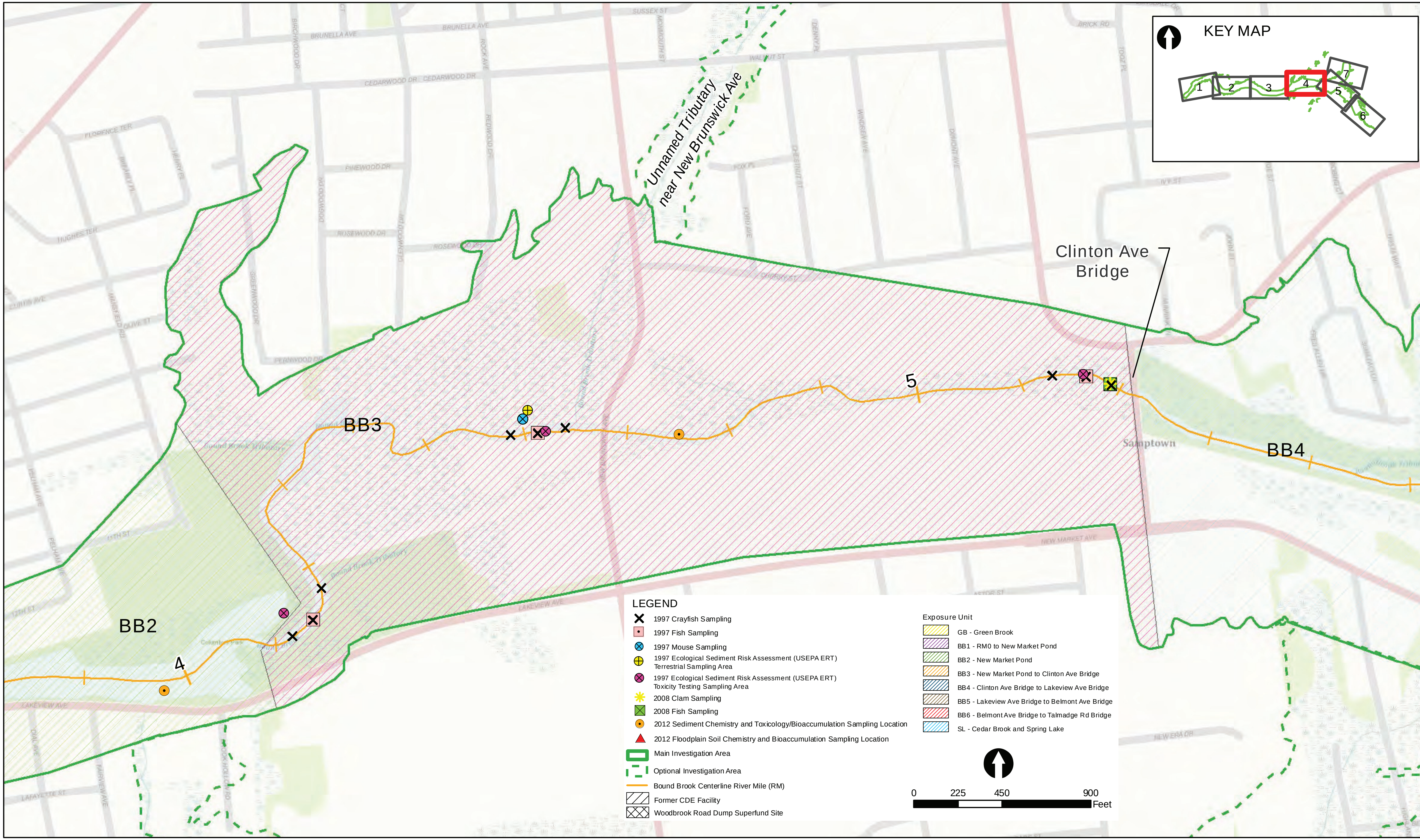
Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	Exposure Unit Boundaries with Historical and Current Biota and Toxicity Testing Sampling Locations *Bound Brook OU4 RI/FS*	2014 Figure 2-5 Sheet 2 of 7



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Biota and Toxicity Testing Sampling Locations
Bound Brook OU4 RI/FS

2014
Figure 2-5
Sheet 3 of 7



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

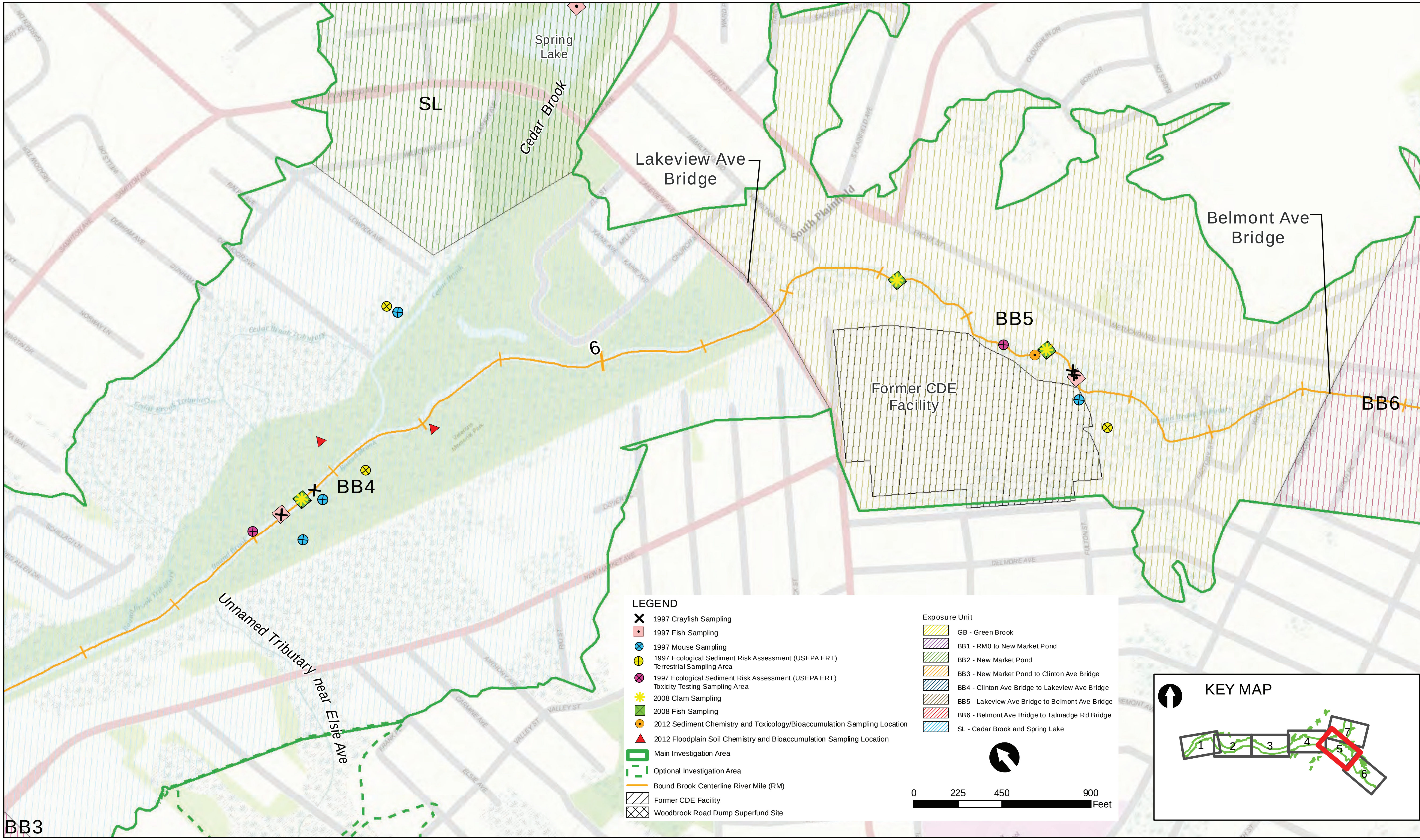
Exposure Unit Boundaries with
Historical and Current Biota and Toxicity Testing Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-5

Sheet 4 of 7



Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

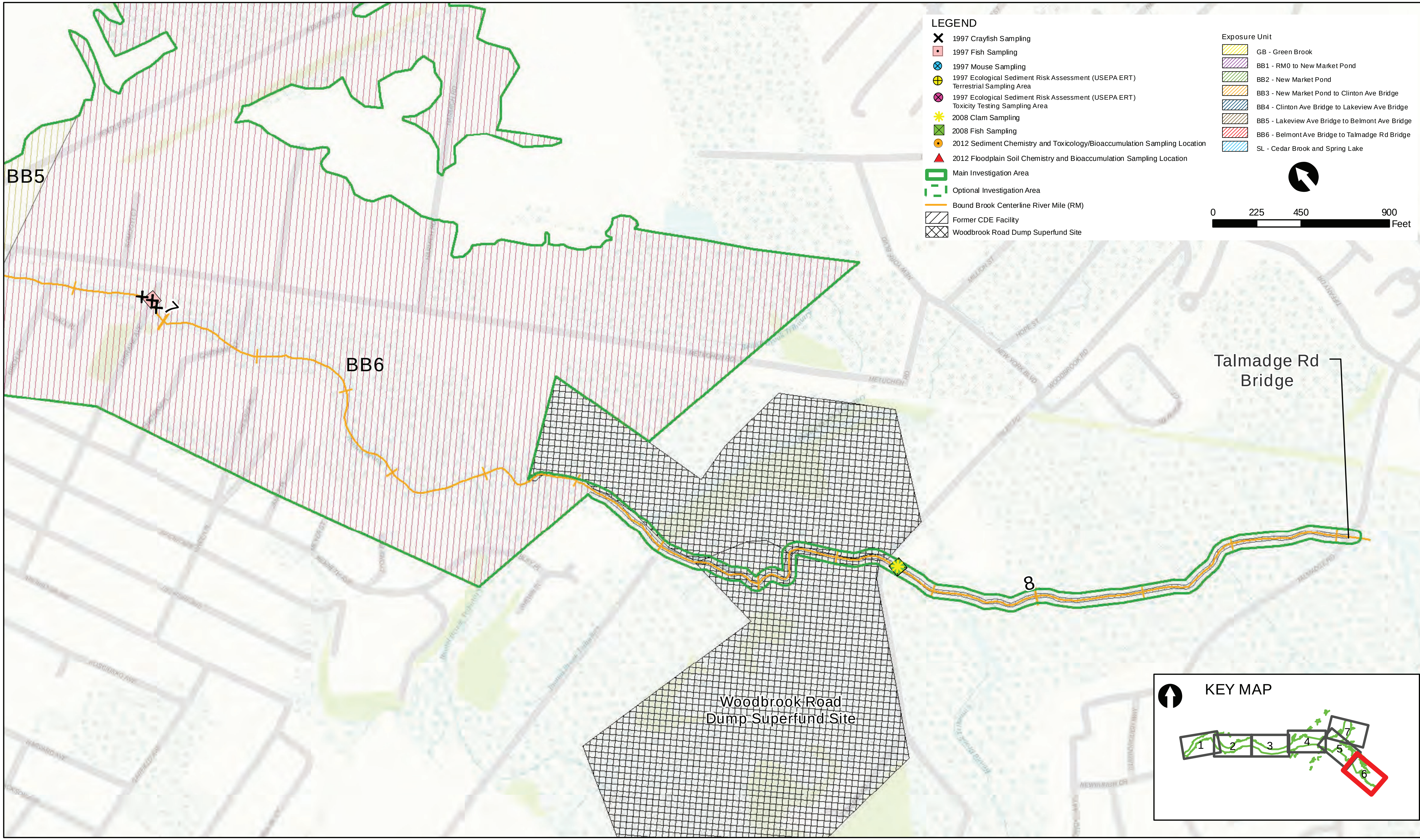
Exposure Unit Boundaries with Historical and Current Biota and Toxicity Testing Sampling Locations

Bound Brook OU4 RI/FS

2014

Figure 2-5

Sheet 5 of 7



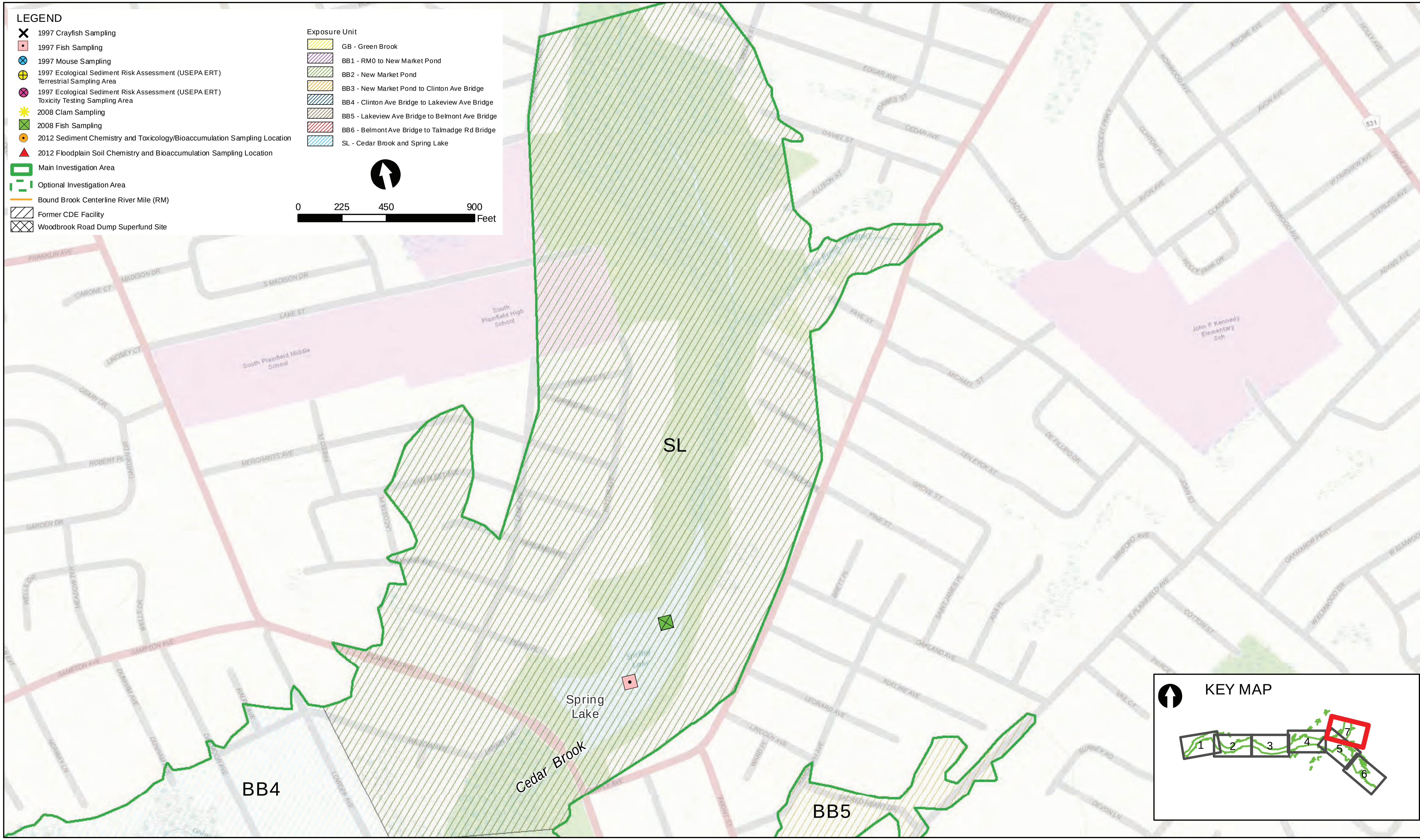
Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with Historical and Current Biota and Toxicity Testing Sampling Locations

Bound Brook OU4 RI/FS

2014

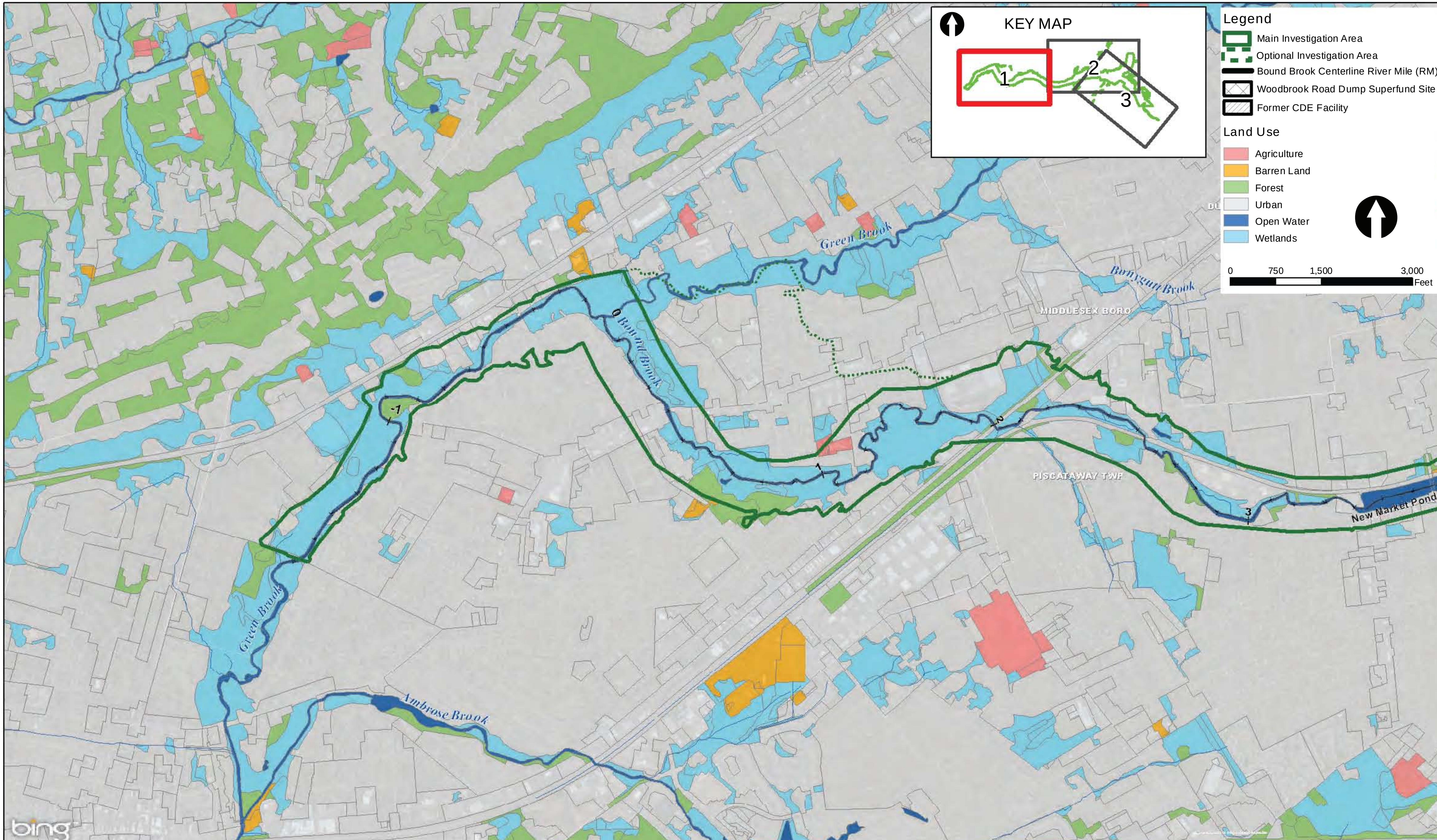
Figure 2-5
Sheet 6 of 7



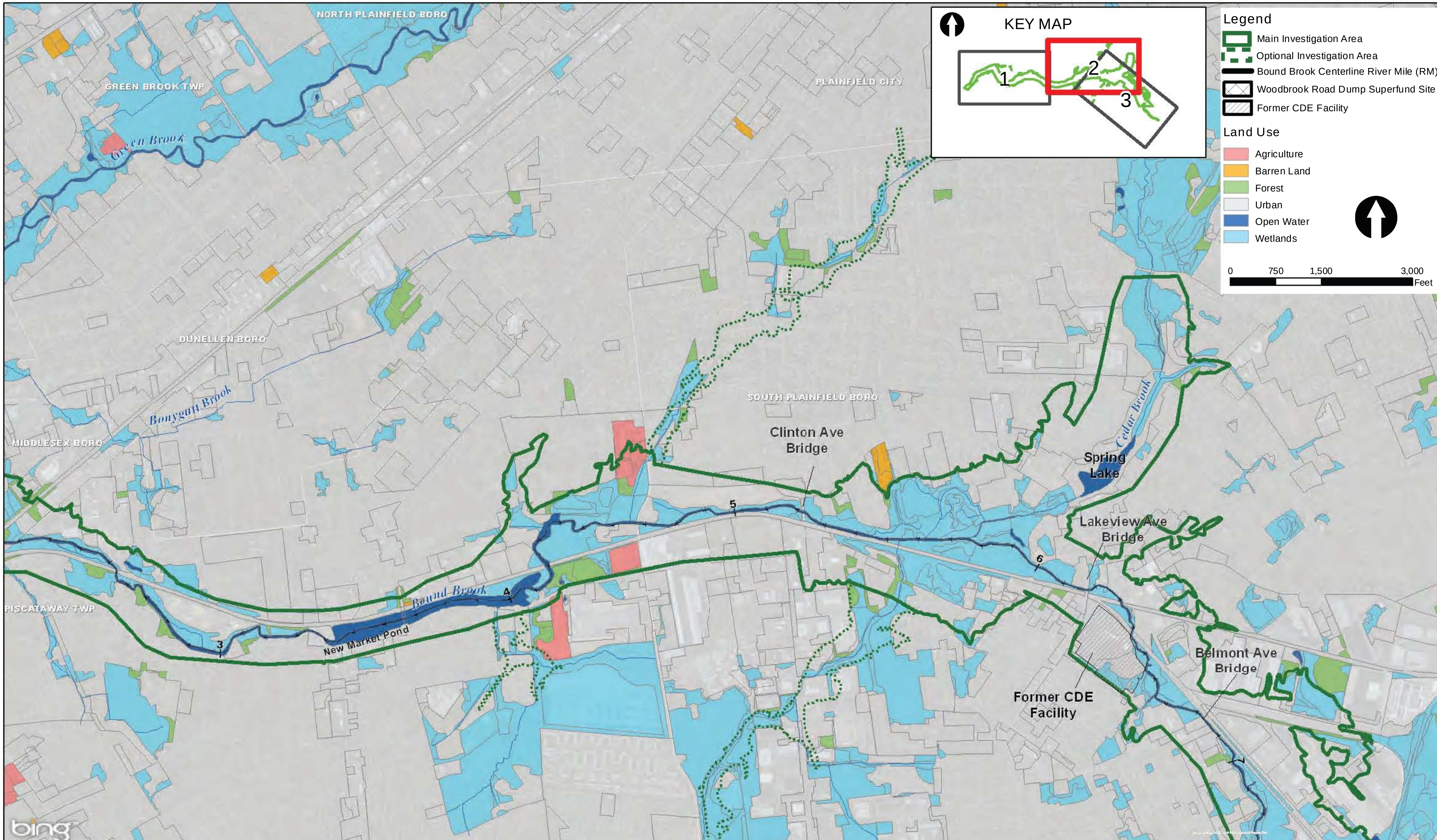
Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

Exposure Unit Boundaries with
Historical and Current Biota and Toxicity Testing Sampling Locations
Bound Brook OU4 RI/FS

2014
Figure 2-5
Sheet 7 of 7



	Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	Land Use in the OU4 Bound Brook Study Area *Bound Brook OU4 RI/FS*	2014 Figure 3-1 Sheet 1 of 3



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

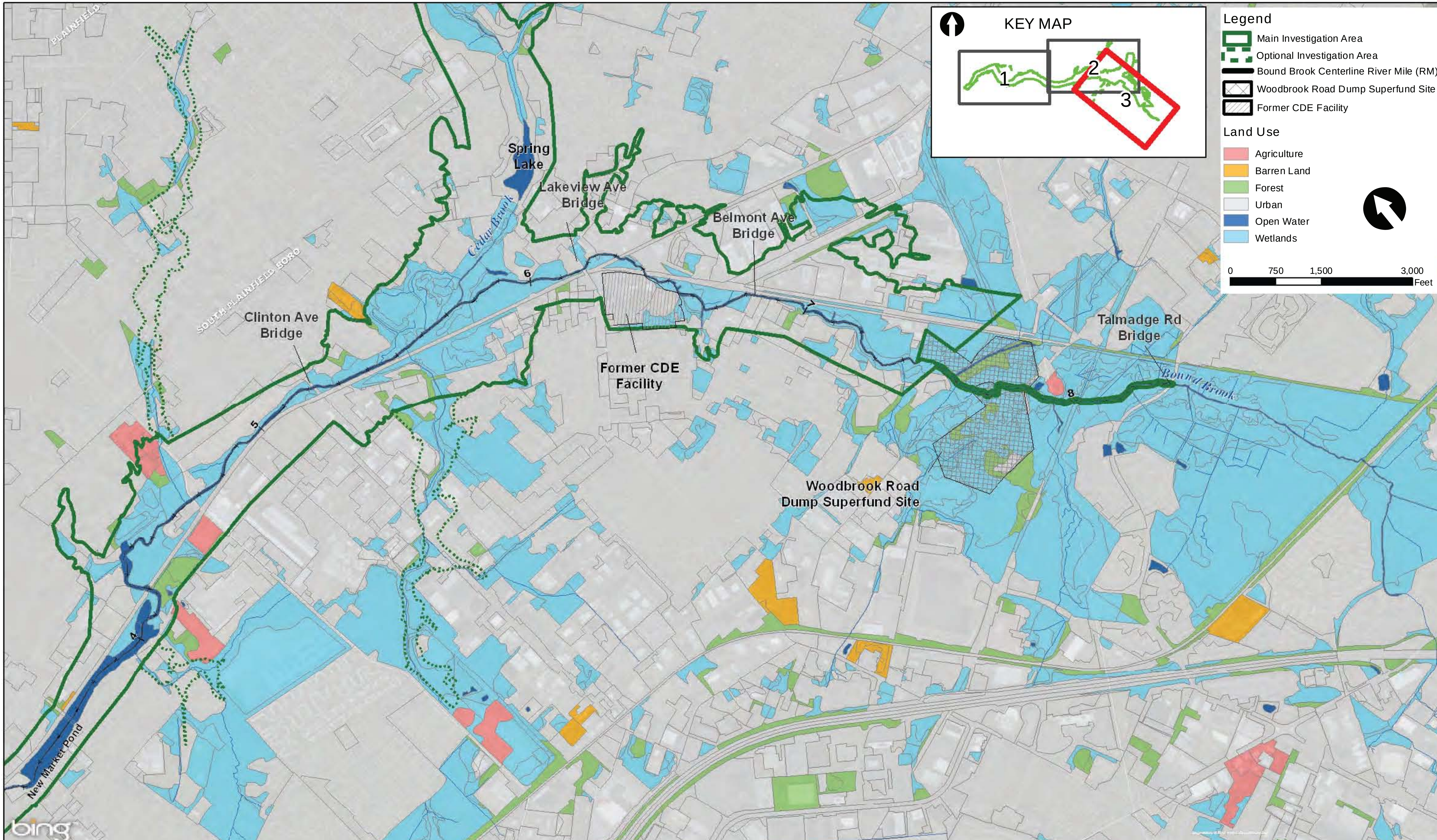
Land Use in the OU4 Bound Brook Study Area

Bound Brook OU4 RI/FS

2014

Figure 3-1

Sheet 2 of 3



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

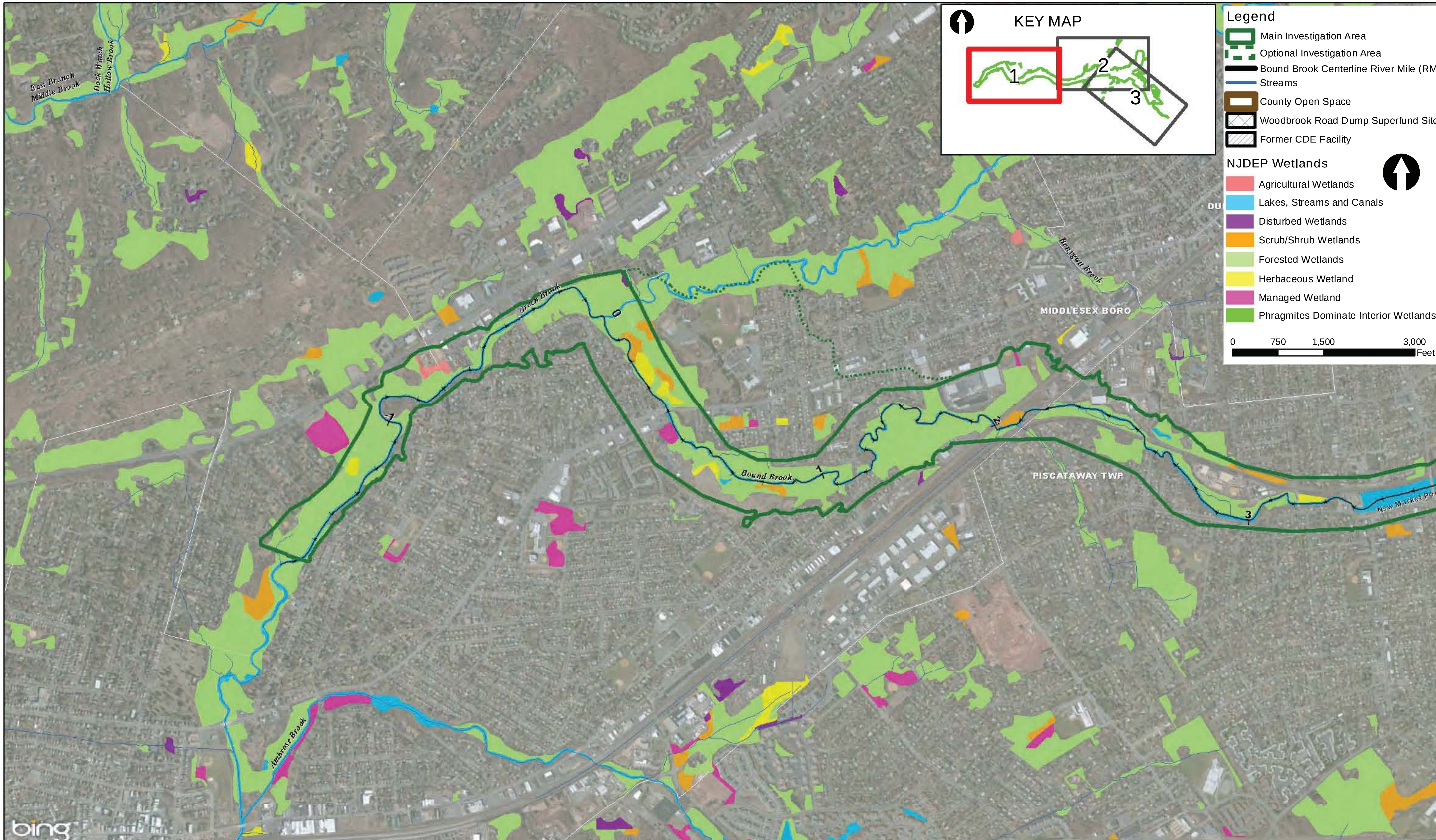
Land Use in the OU4 Bound Brook Study Area

Bound Brook OU4 RI/FS

2014

Figure 3-1

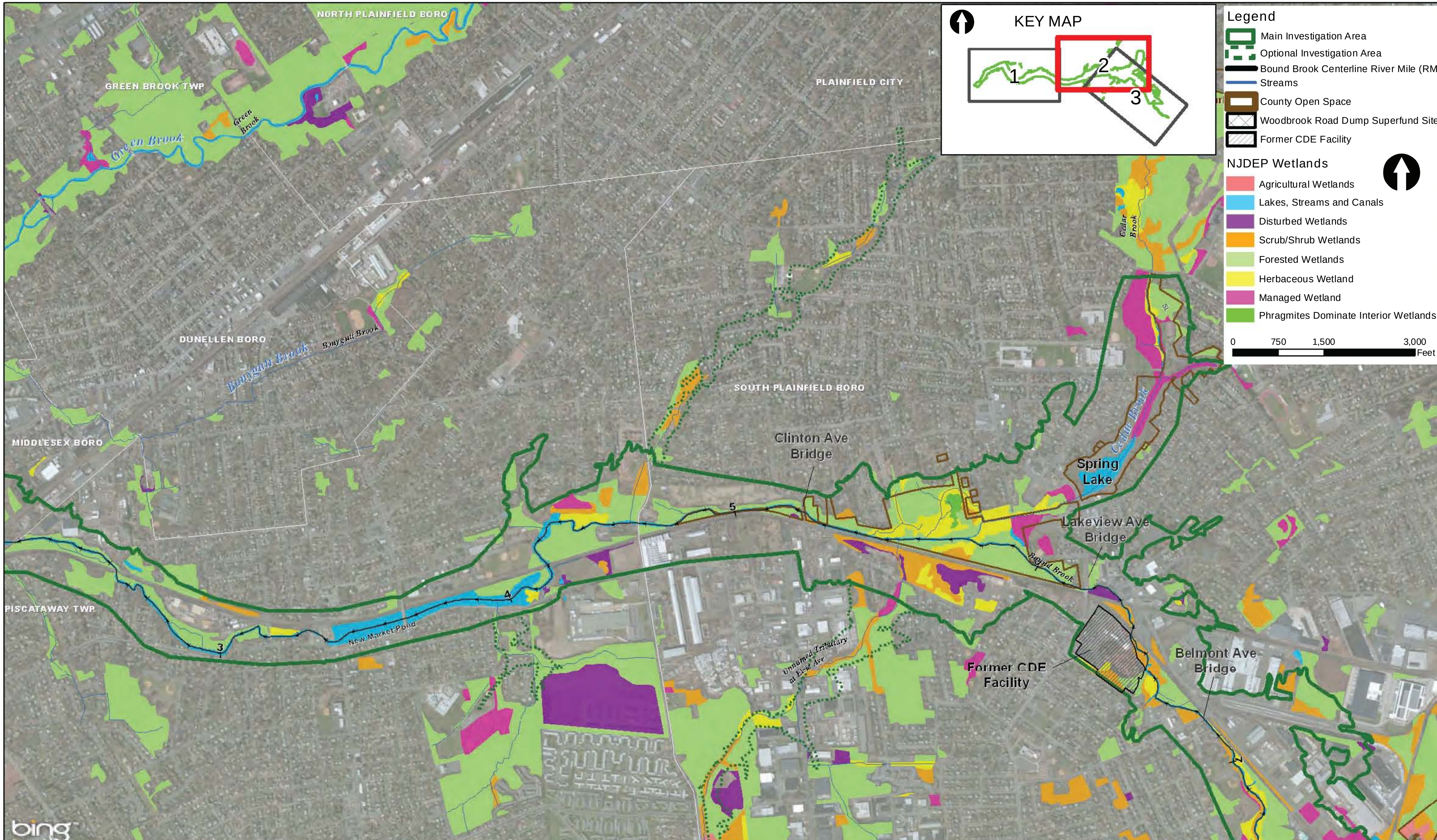
Sheet 3 of 3



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

NJDEP Wetlands, Streams, and Open Space
in the OU4 Bound Brook Study Area
Bound Brook OU4 RI/FS

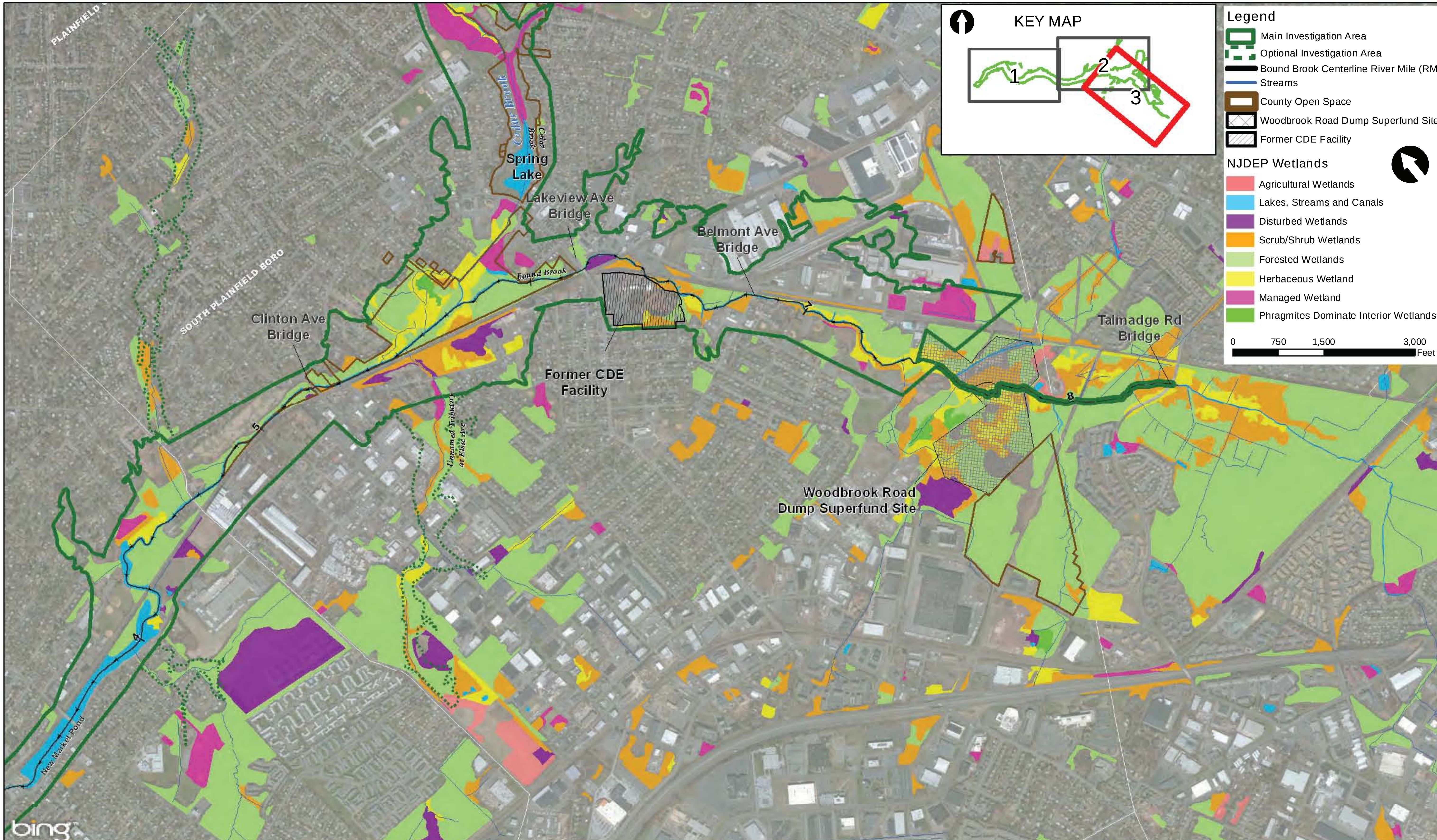
2014
Figure 4-6
Sheet 1 of 3



Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

NJDEP Wetlands, Streams, and Open Space
in the OU4 Bound Brook Study Area
Bound Brook OU4 RI/FS

2014
Figure 4-6
Sheet 2 of 3

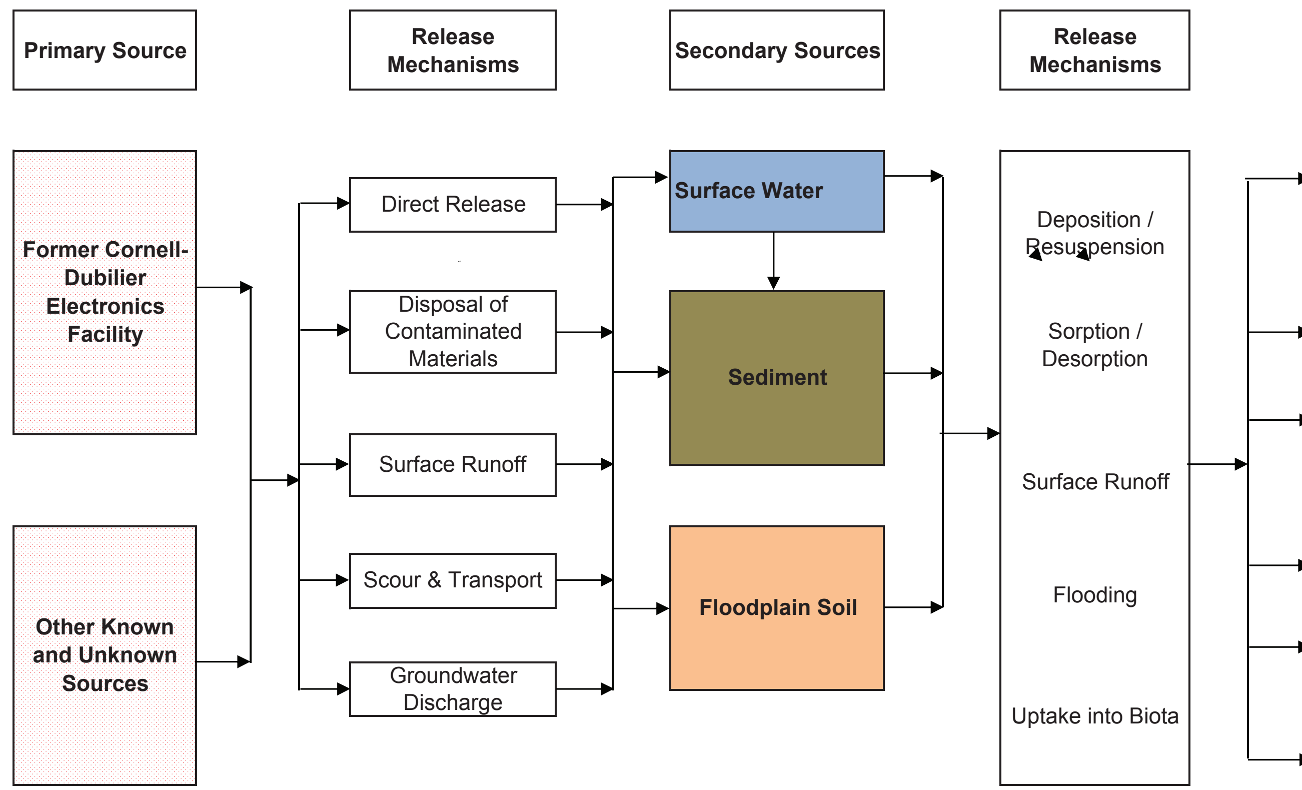


Cornell-Dubilier Electronics
Superfund Site
South Plainfield, New Jersey

NJDEP Wetlands, Streams, and Open Space
in the OU4 Bound Brook Study Area
Bound Brook OU4 RI/FS

2014

Figure 4-6
Sheet 3 of 3



		POTENTIAL HUMAN RECEPTOR - CURRENT/FUTURE SCENARIO					
Exposure Media	**Exposure Routes**	Recreationist / Sportsman	Angler	Outdoor Worker	Commercial / Industrial Worker	Resident	Construction / Utility Worker
Surface Water	Ingestion						
	Dermal Contact	●	●	●			
	Inhalation	●	●	●			
Sediment - Surface	Ingestion	●	●	●			
	Dermal Contact	●	●	●			
	Inhalation						
Sediment - Subsurface	Ingestion			●			
	Dermal Contact			●			
	Inhalation						
Floodplain Soil - Surface	Ingestion	●	●	●	●	●	●
	Dermal Contact	●	●	●	●	●	●
	Inhalation	●	●	●	●	●	●
Floodplain Soil - Subsurface	Ingestion			●		●	●
	Dermal Contact			●		●	●
	Inhalation			●		●	●
Biota	Ingestion		●				

LEGEND:

● = Potentially Complete Exposure Pathway

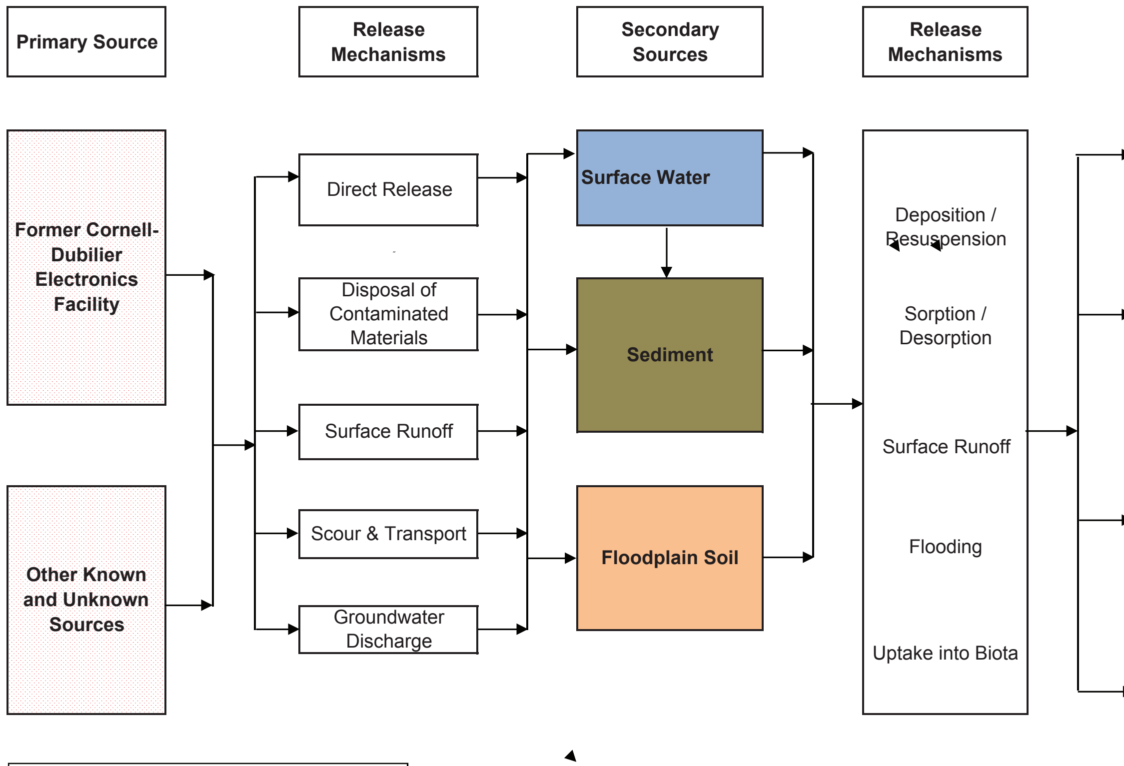
→ = Release Mechanism

Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

Human Health Conceptual Site Exposure Model
Bound Brook OU4 RI/FS

2014

Figure 3-3



Exposure Media	Exposure Routes	POTENTIAL ECOLOGICAL RECEPTOR									
		Aquatic Plants	Benthic Invertebrates	Freshwater Fish	Semi-Aquatic Birds	Semi-Aquatic Mammals	Reptiles / Amphibians	Terrestrial Plants	Terrestrial Invertebrates	Terrestrial Birds	Terrestrial Mammals
Surface Water	Ingestion				●	●	●			●	●
	Dermal Contact				●	●	●				
	Respiration			●			●				
	Root Uptake/Absorption	●	●	●							
Sediment	Ingestion		●	●	●	●	●				
	Dermal Contact				●	●	●				
	Root Uptake/Absorption	●	●								
Floodplain Soil	Ingestion						●		●	●	●
	Dermal Contact						●	●	●	●	●
	Root Uptake/Absorption							●	●		
Biota	Ingestion		●	●	●	●	●		●	●	●

LEGEND:

● = Potentially Complete Exposure Pathway

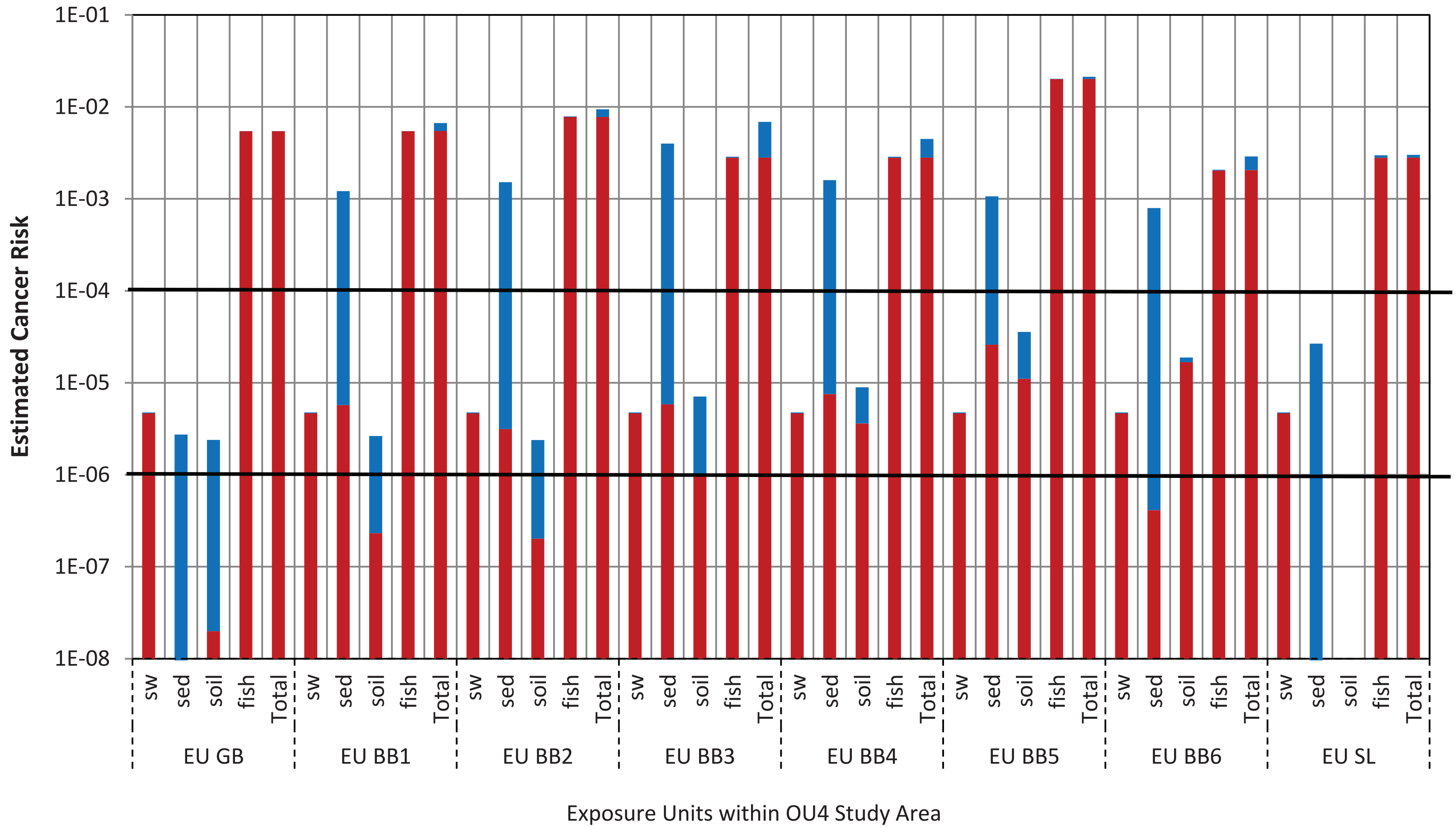
→ = Release Mechanism

Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

Ecological Conceptual Site Exposure Model
Bound Brook OU4 RI/FS

2014

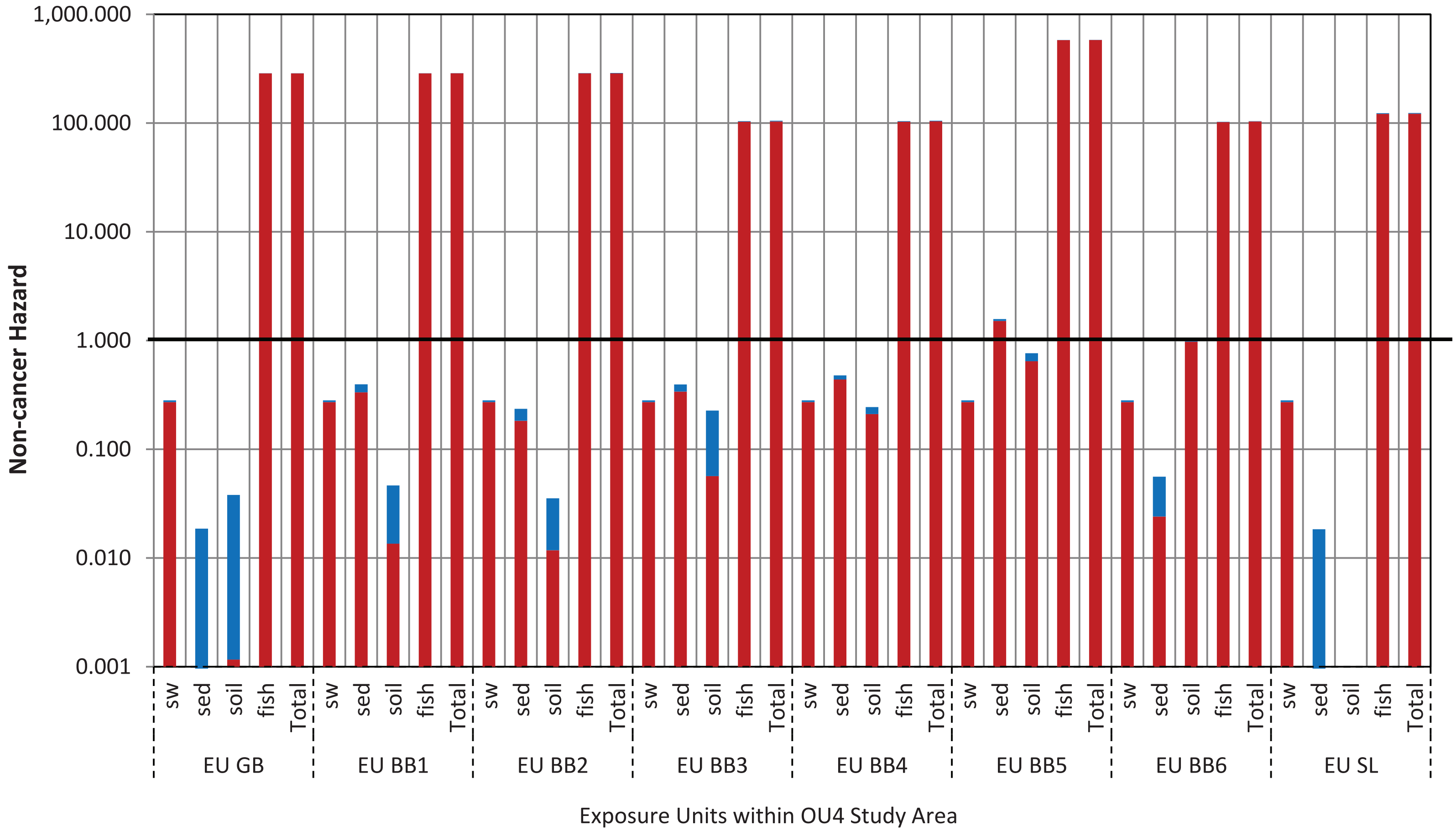
Figure 3-4



LEGEND:

Non-PCB contribution	sw = surface water	soil = surface soil	Total = total cancer risk
PCB contribution	sed = sediment	fish = bottom-feeding fish fillet	

	Cornell-Dubilier Electronics Superfund Site South Plainfield, New Jersey	**Adult Angler Cancer Risks - Bottom-Feeding Fish Fillet** *Bound Brook OU4 RI/FS*	2014 FIGURE 4-1



LEGEND:

Non-PCB contribution
PCB contribution

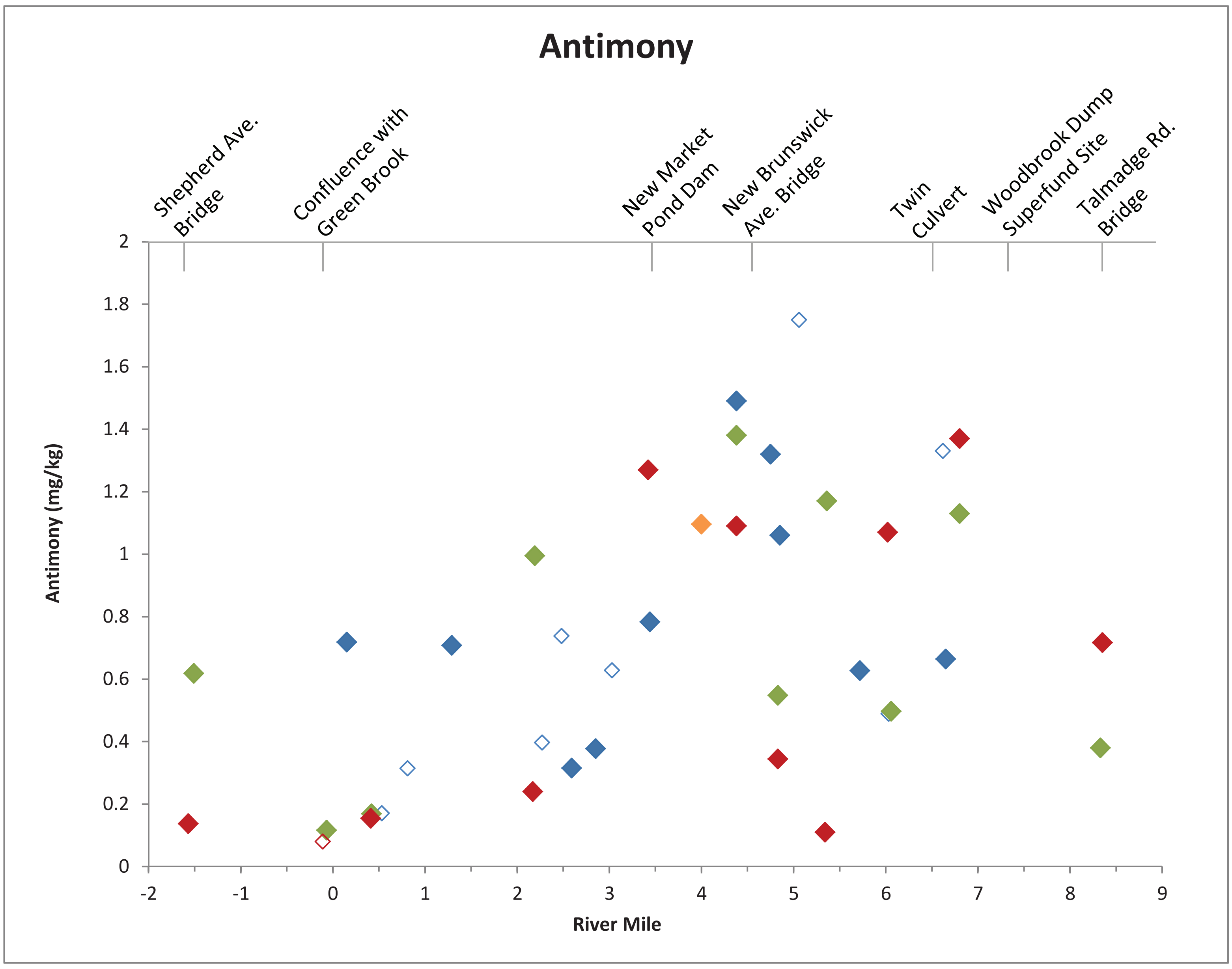
sw = surface water
sed = sediment
soil = surface soil
fish = bottom-feeding fish fillet
Total = total non-cancer hazard

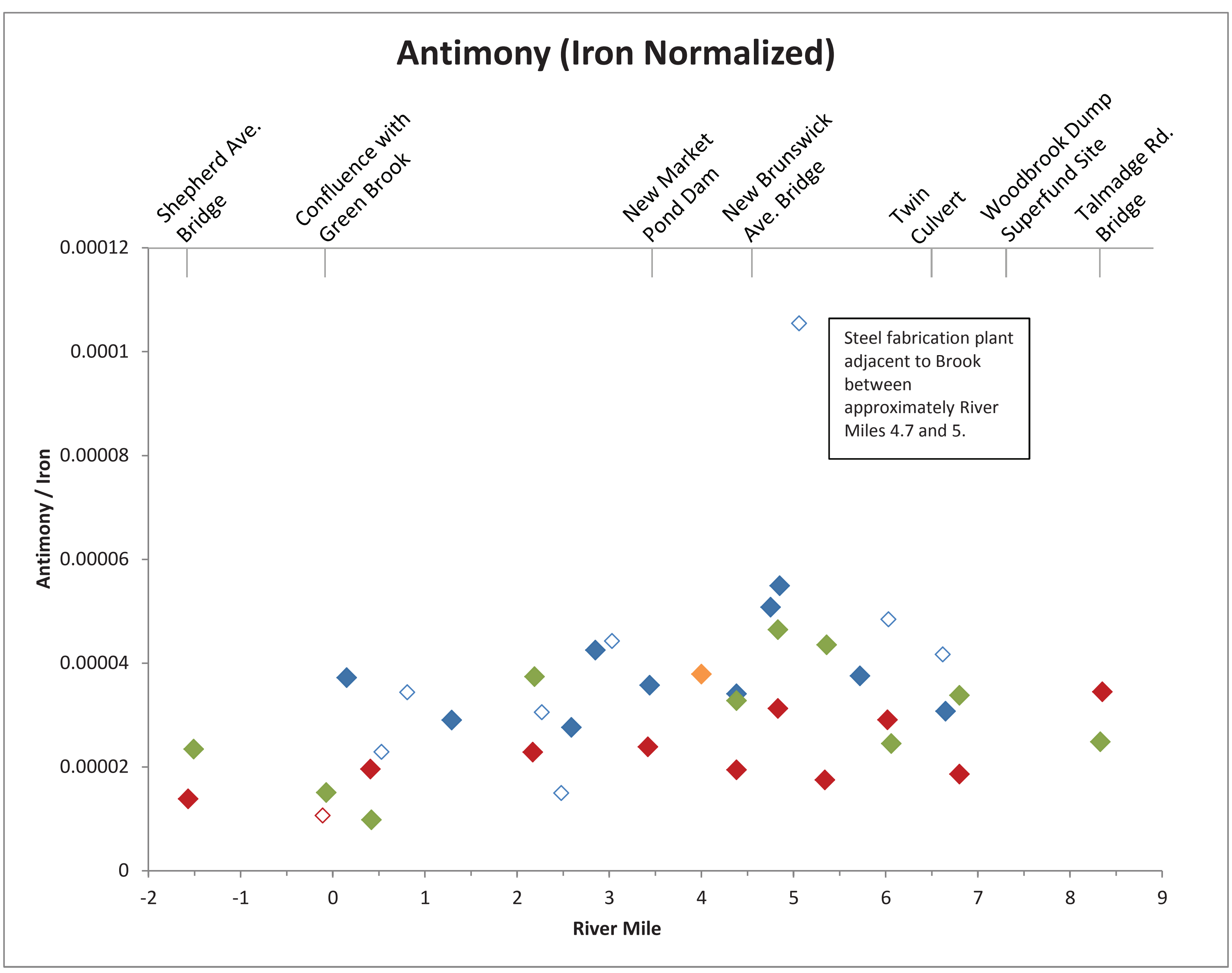
Cornell-Dubilier Electronics Superfund Site
South Plainfield, New Jersey

Adult Angler Non-cancer Hazards - Bottom-Feeding Fish Fillet
Bound Brook OU4 RI/FS

2014

FIGURE 4-2

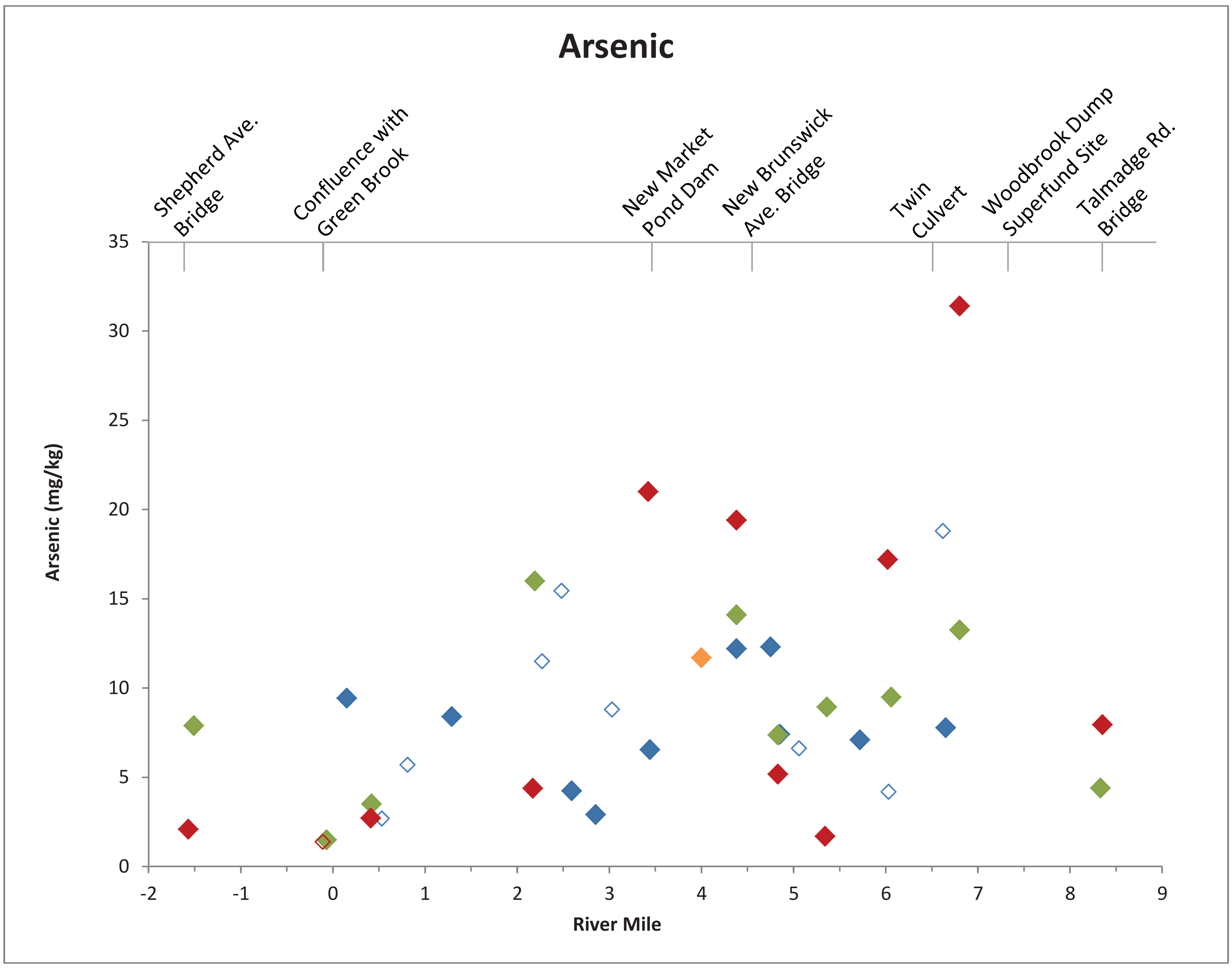


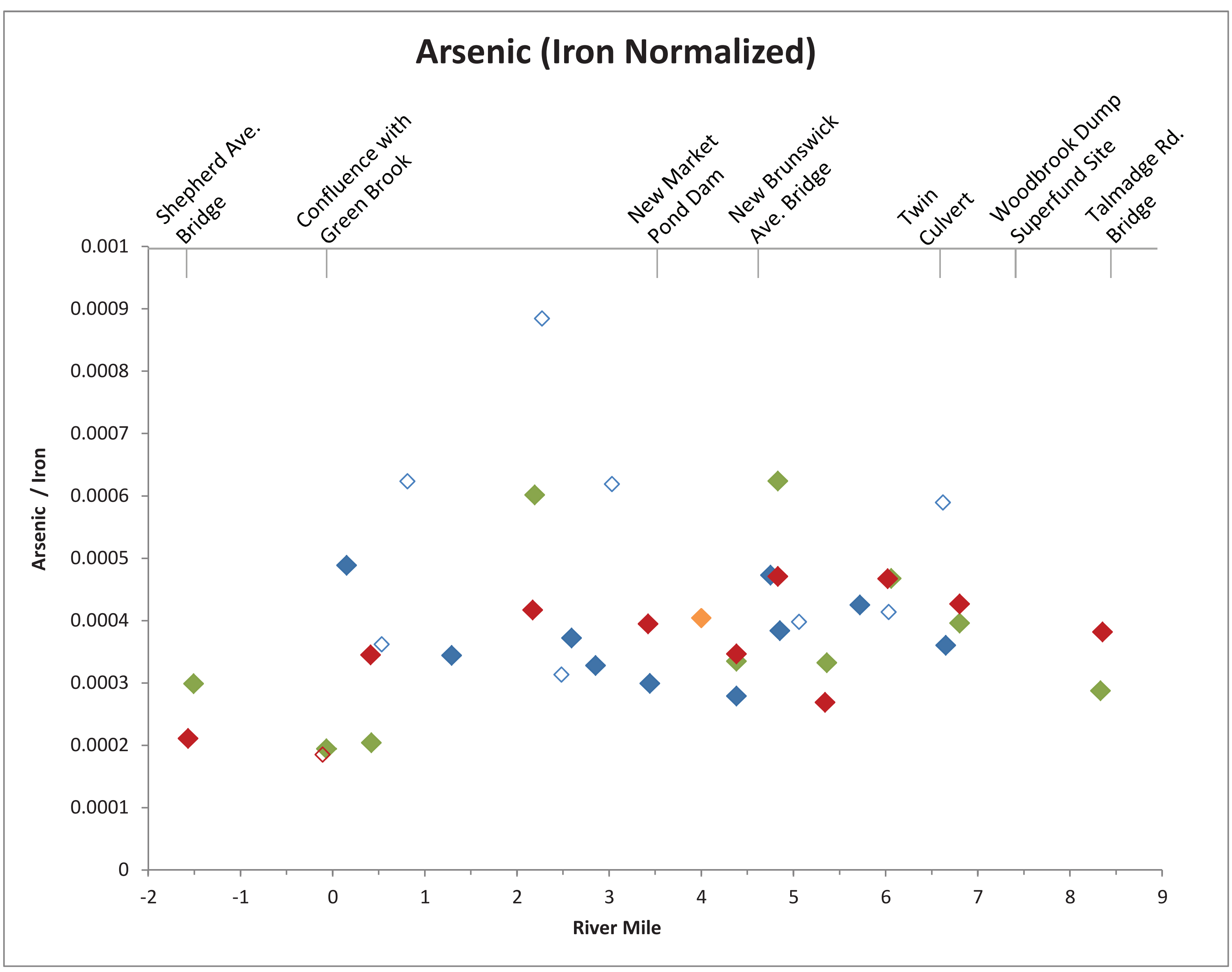


LEGEND:
- ◆ April 2011 Surface Sediment (Be7 bearing)
- ◇ April 2011 Surface Sediment (non-Be7 bearing)
- ◆ April 2011 High Resolution Core Top (Be7 bearing)
- ◆ Nov 2011 Surface Sediment (Be7 bearing)
- ◆ Nov 2011 Sediment Trap (Be7 bearing)
- ◇ Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Antimony)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1a

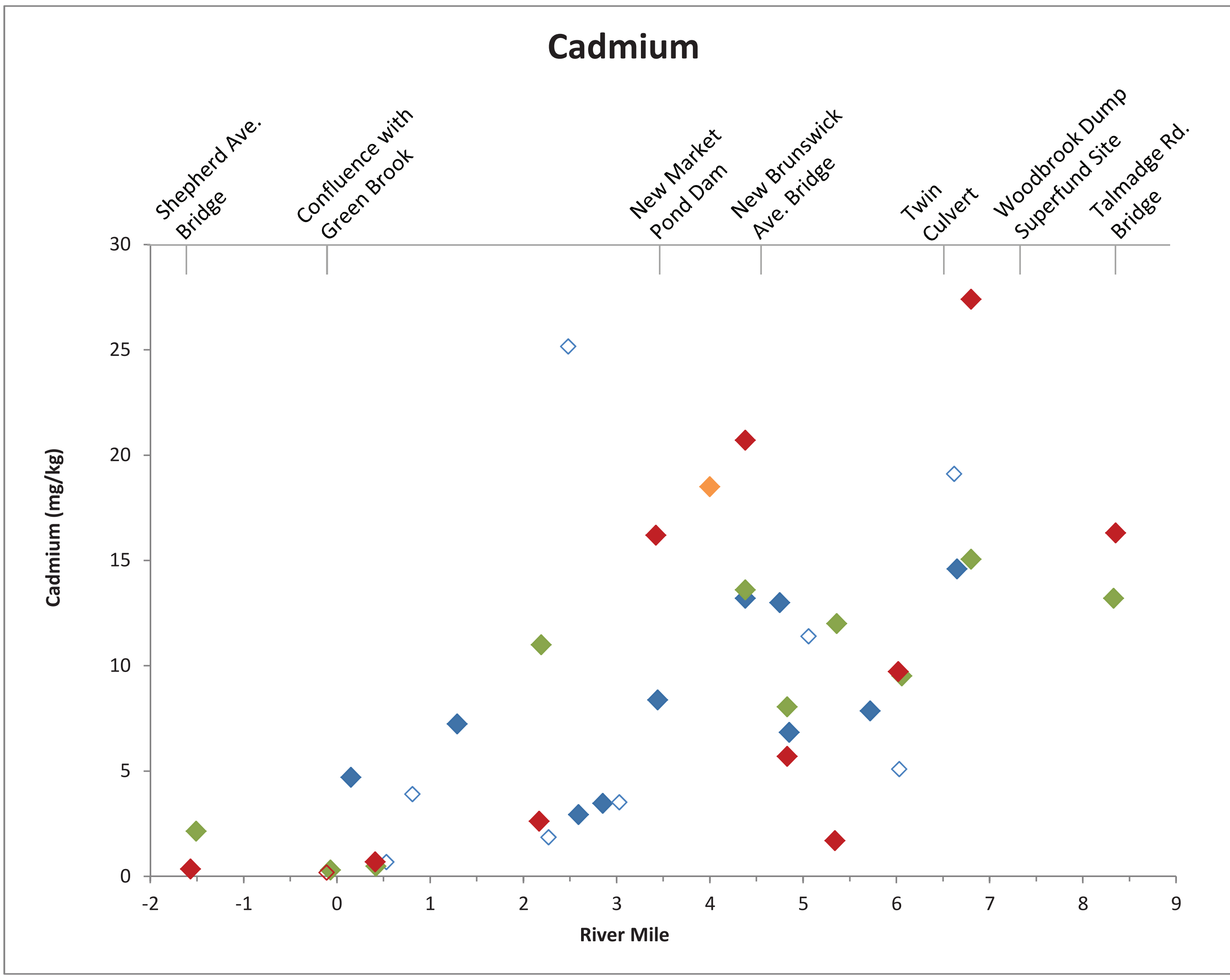


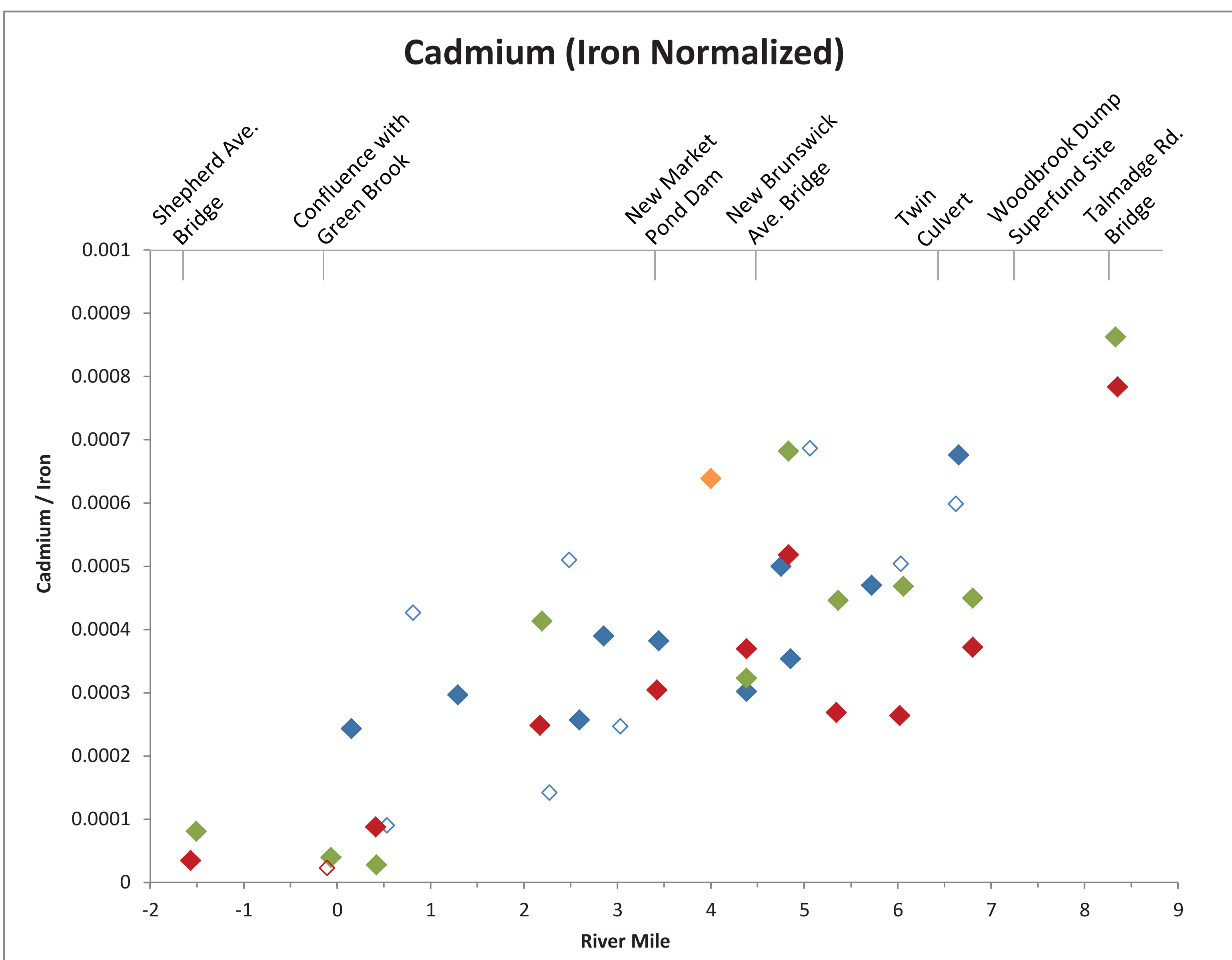


LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Arsenic)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1b

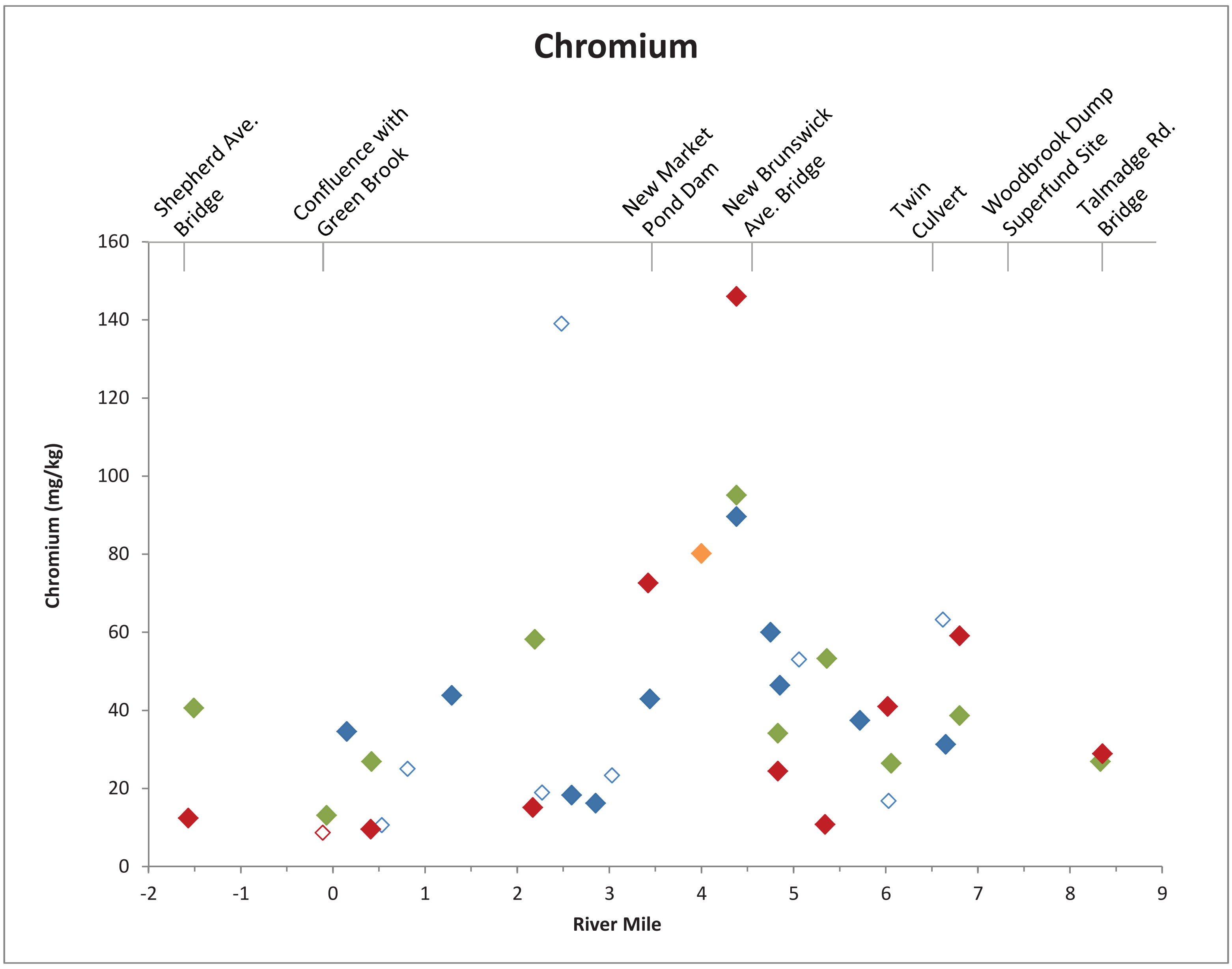


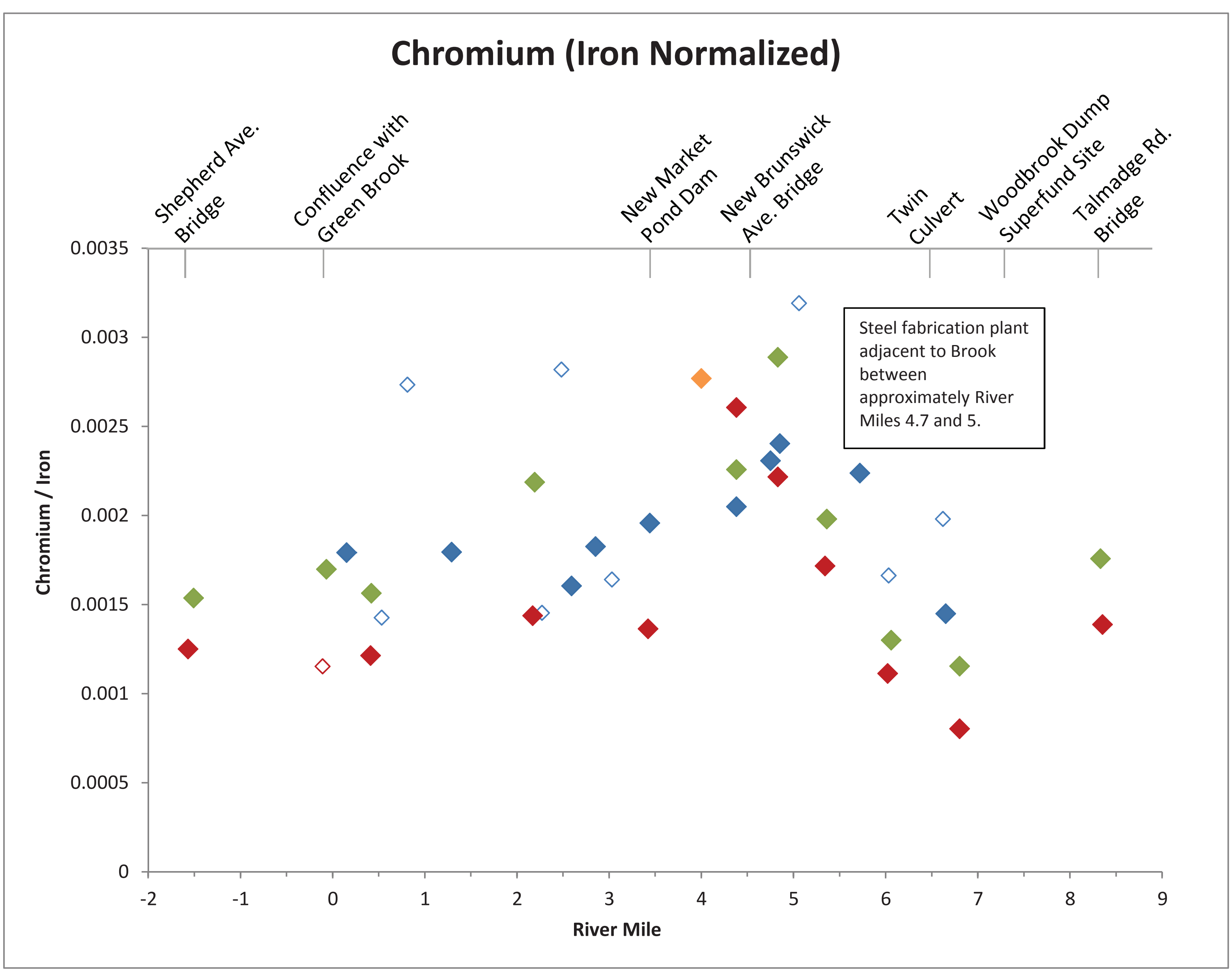


LEGEND:
- ◆ April 2011 Surface Sediment (Be7 bearing)
- ◇ April 2011 Surface Sediment (non-Be7 bearing)
- ◆ April 2011 High Resolution Core Top (Be7 bearing)
- ◆ Nov 2011 Surface Sediment (Be7 bearing)
- ◆ Nov 2011 Sediment Trap (Be7 bearing)
- ◇ Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Cadmium)** *Bound Brook OU4 RI/FS*	2014	FIGURE 5-1c

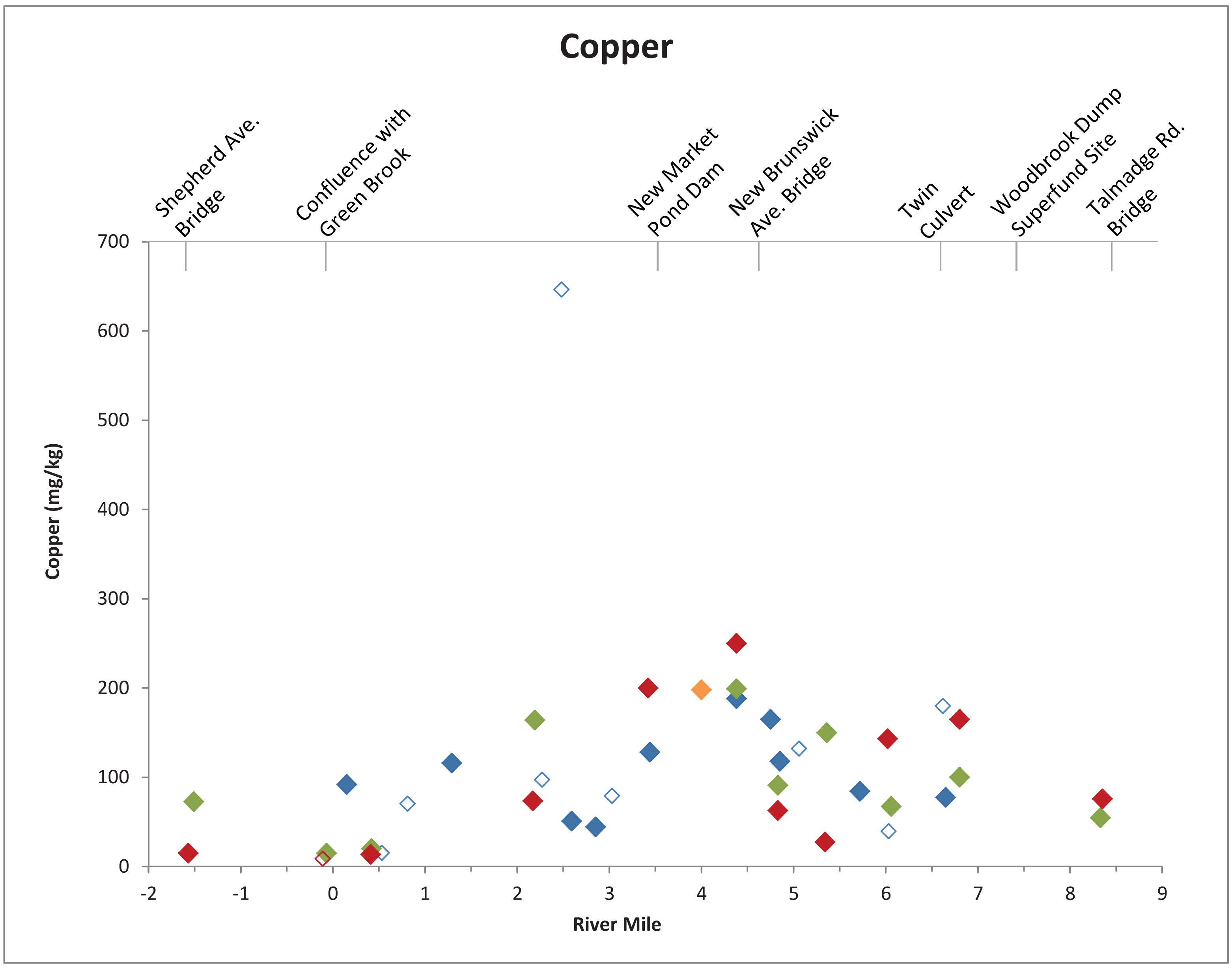


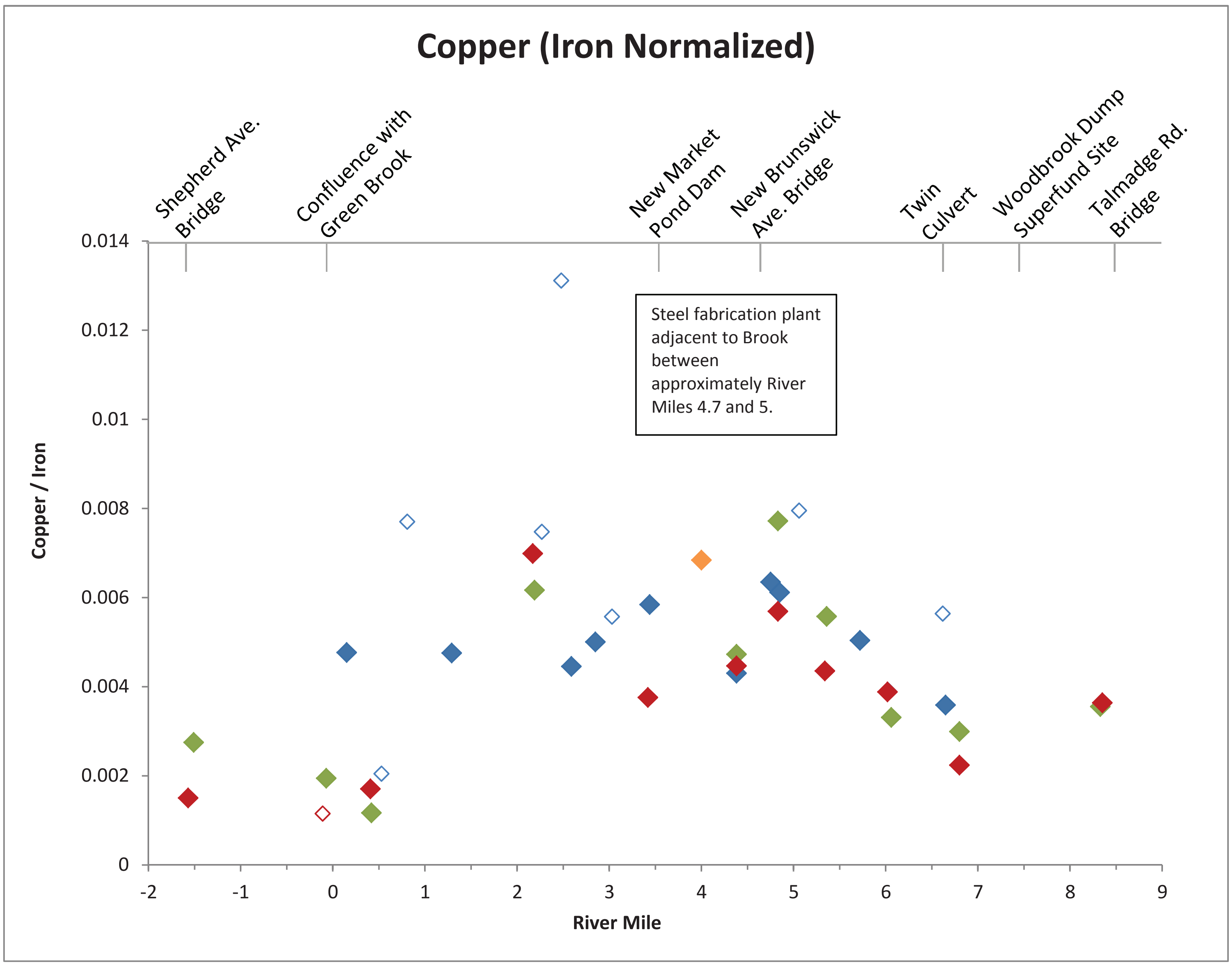


LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Chromium)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1d

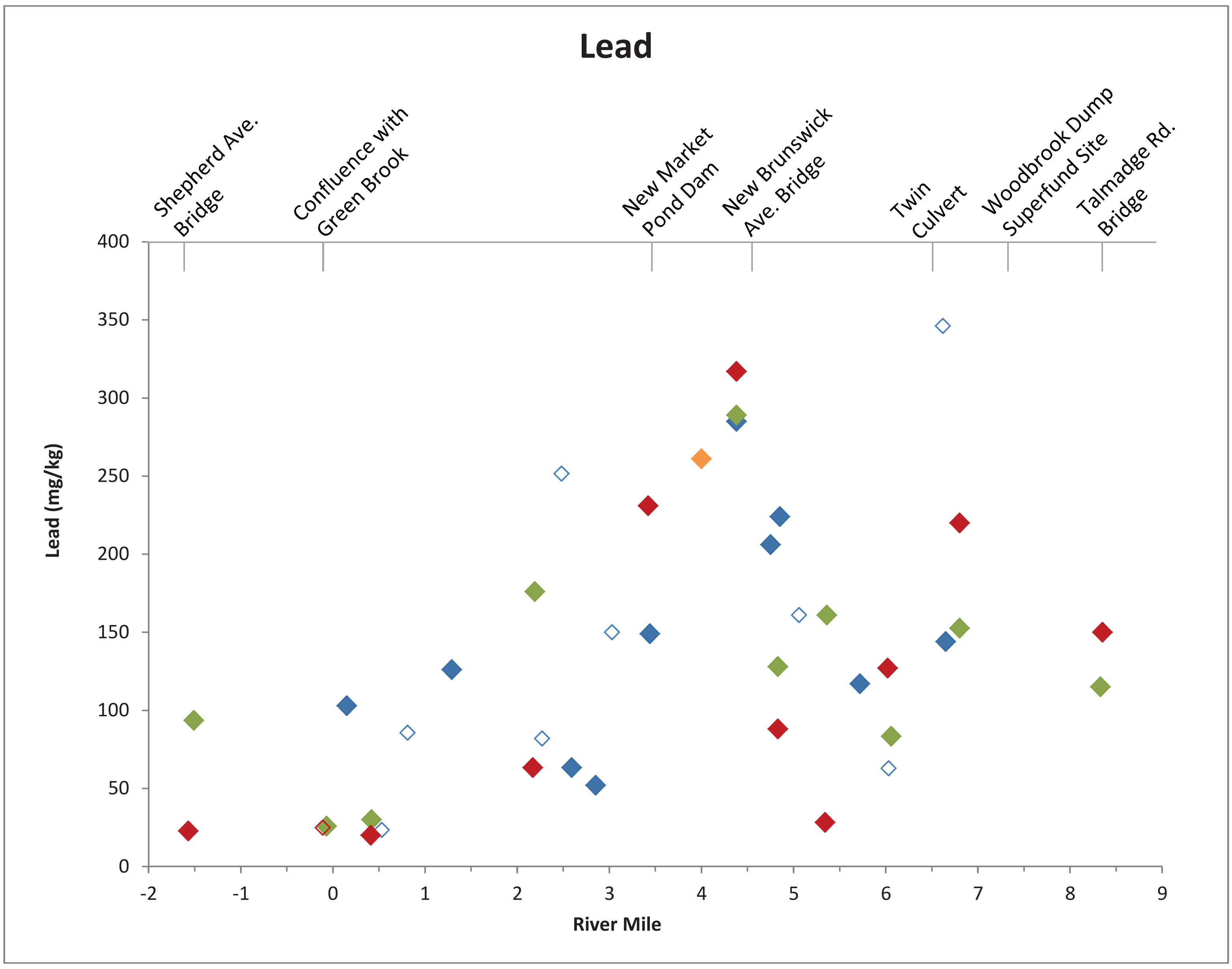


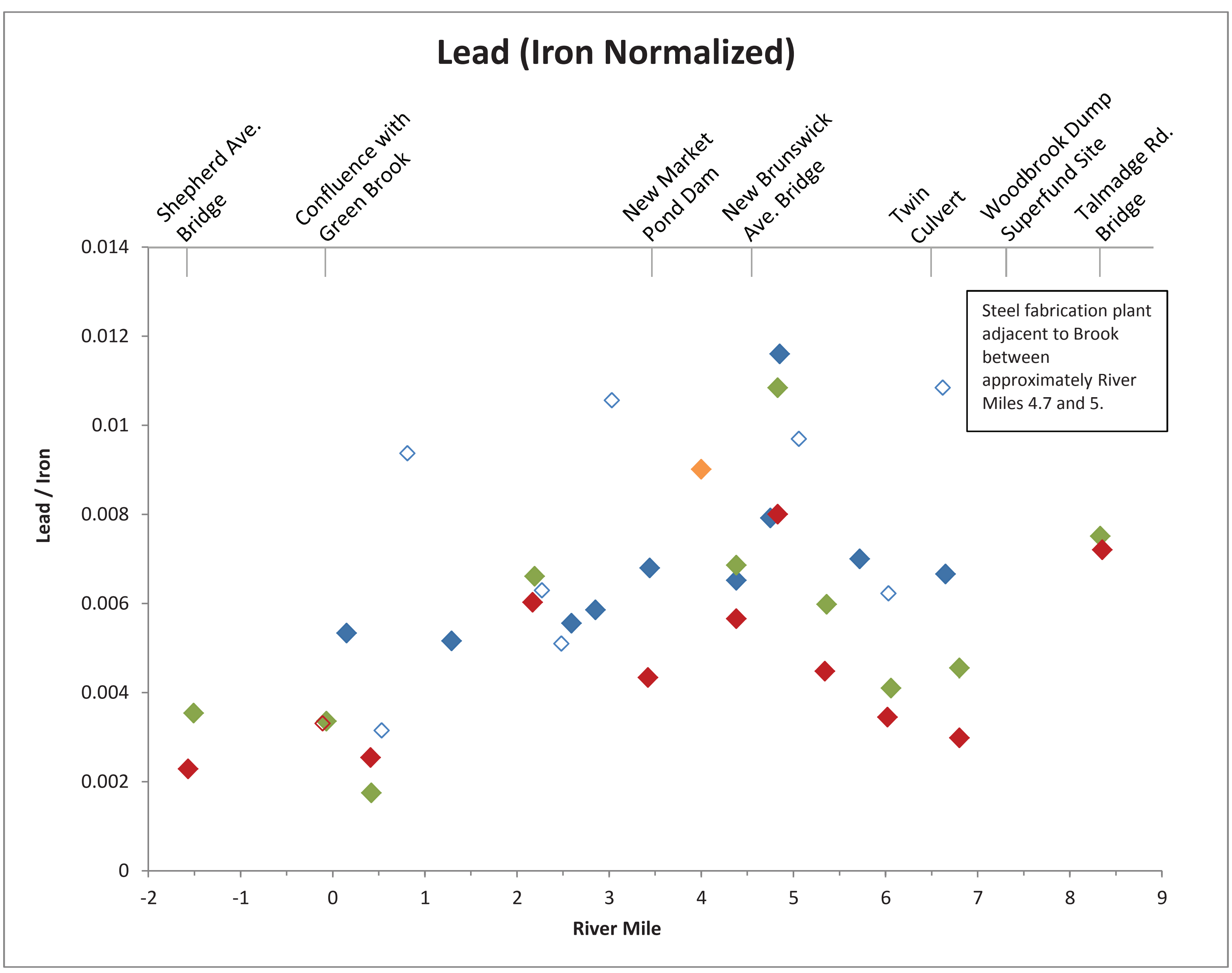


LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Copper)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1e





LEGEND:

- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:

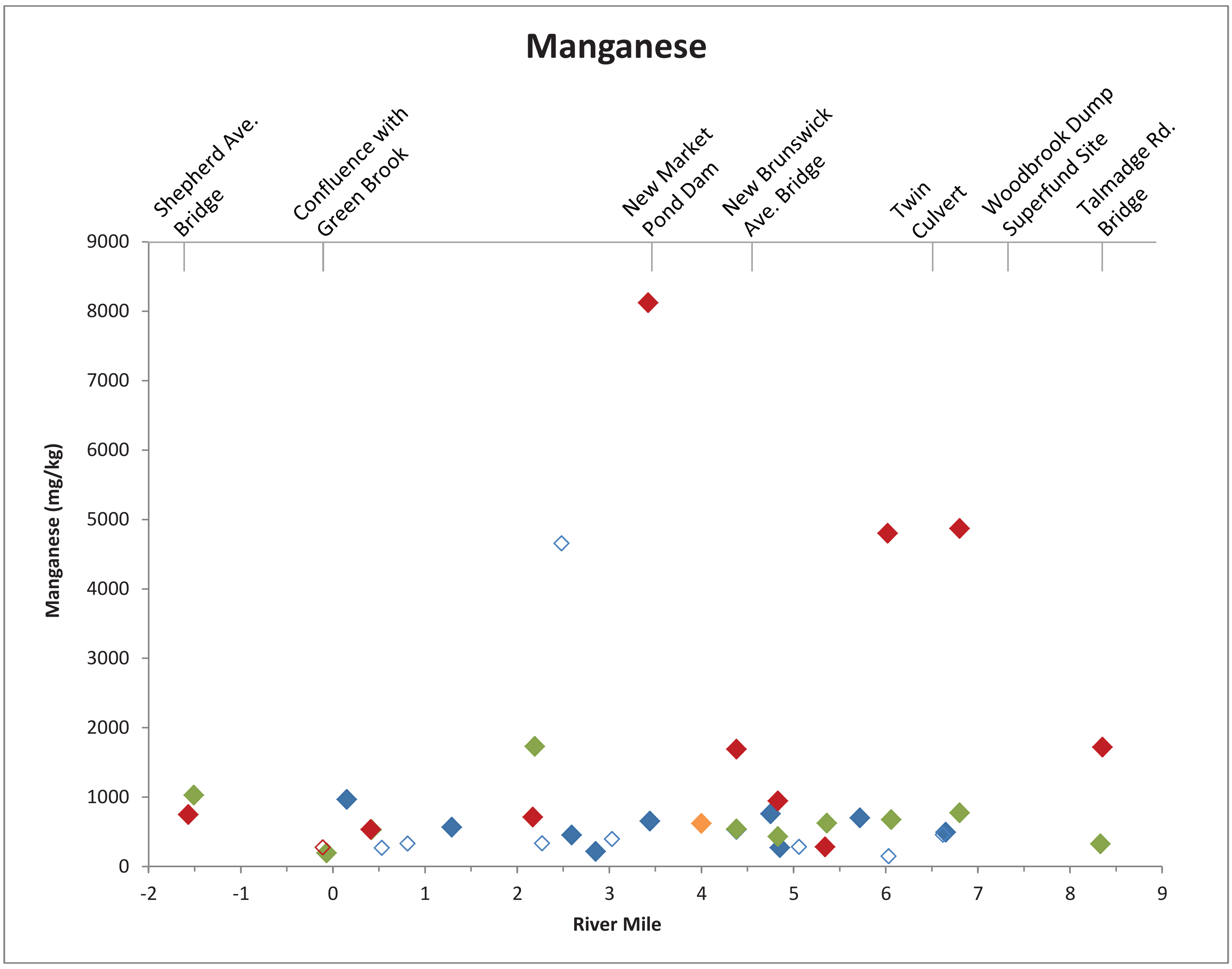
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

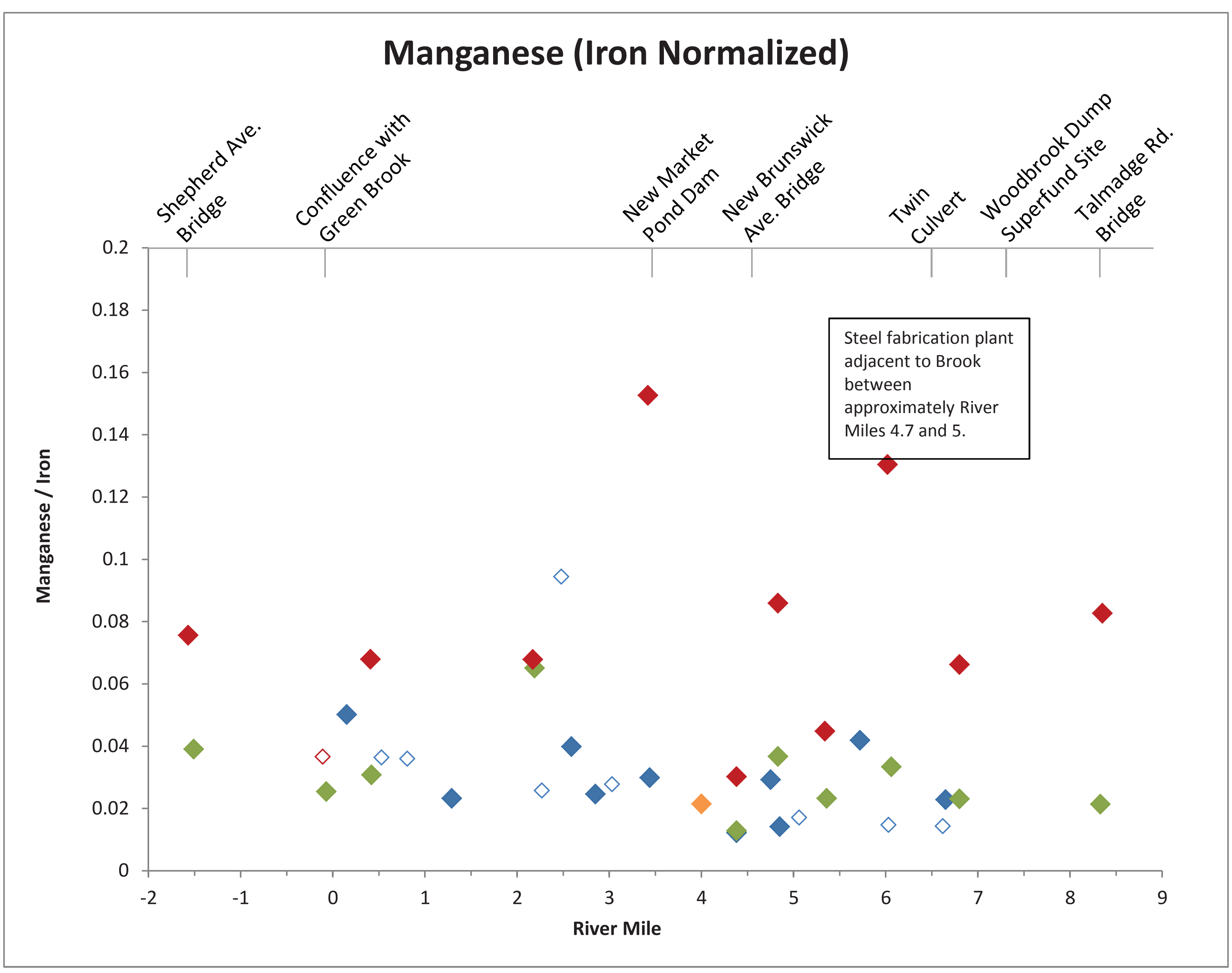
Cornell-Dubilier Electronics Superfund Site
South Plainfield, NJ

Metals Concentrations in Recently Deposited Sediments (Lead)
Bound Brook OU4 RI/FS

2014

FIGURE 5-1f

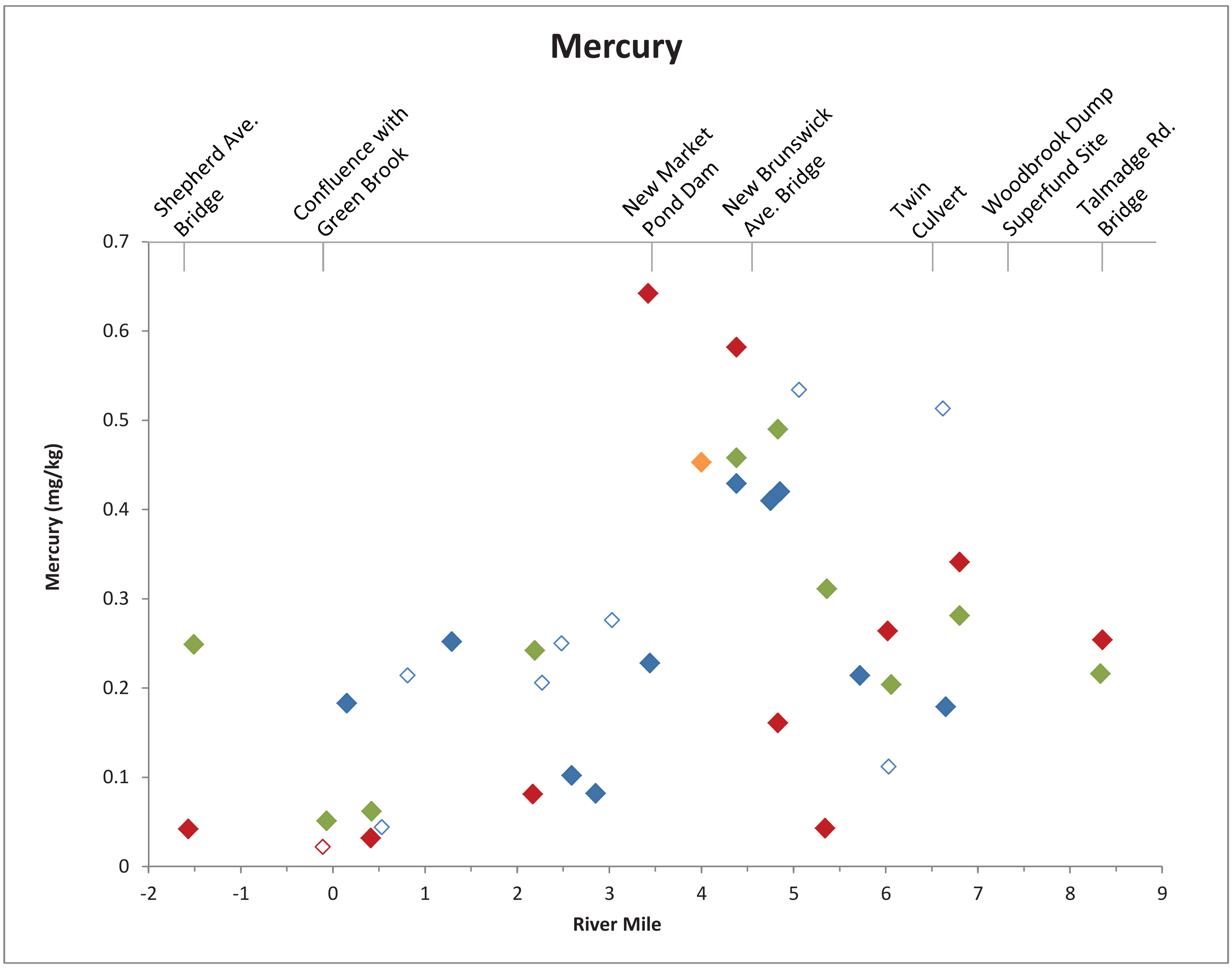


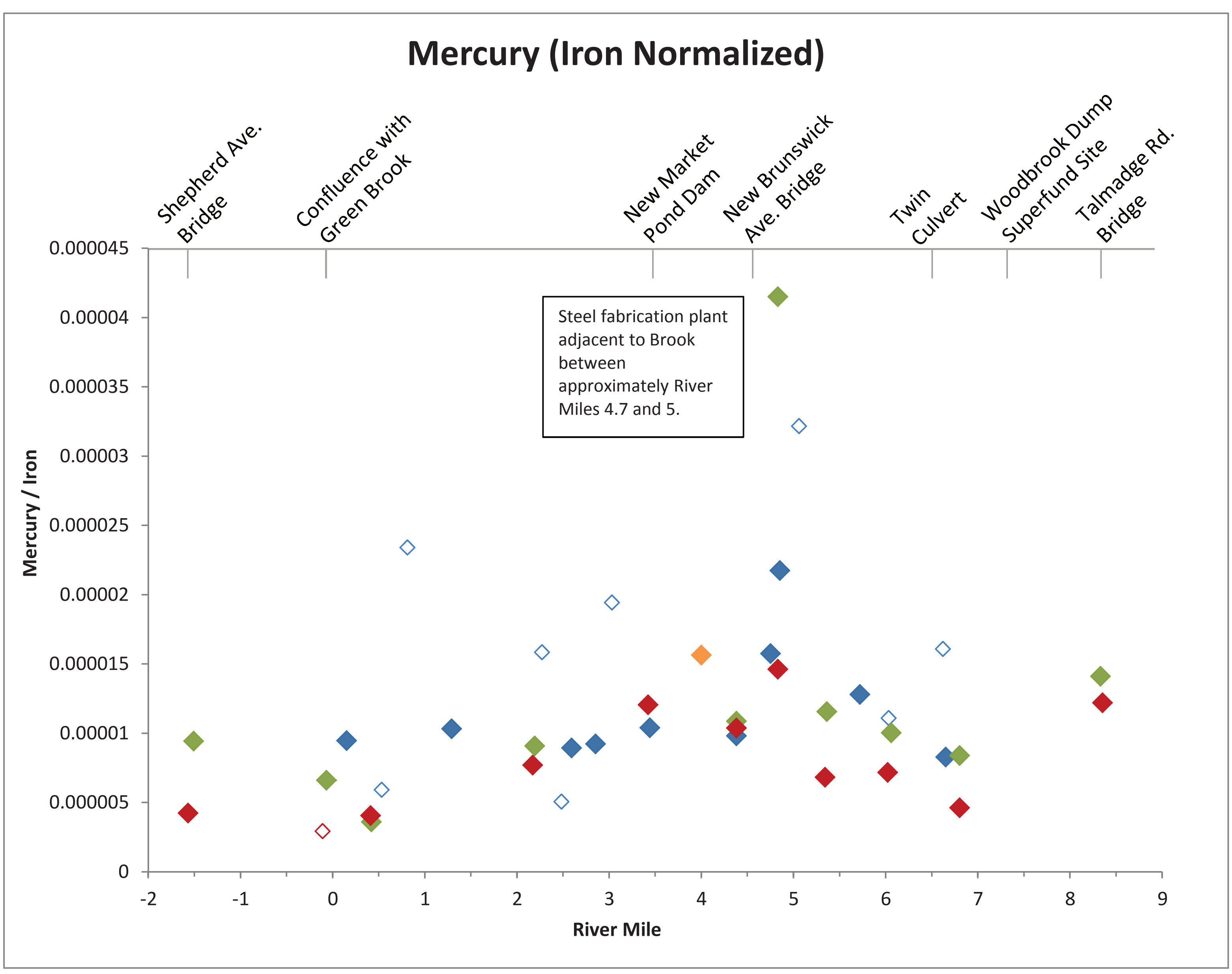


LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Manganese)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1g



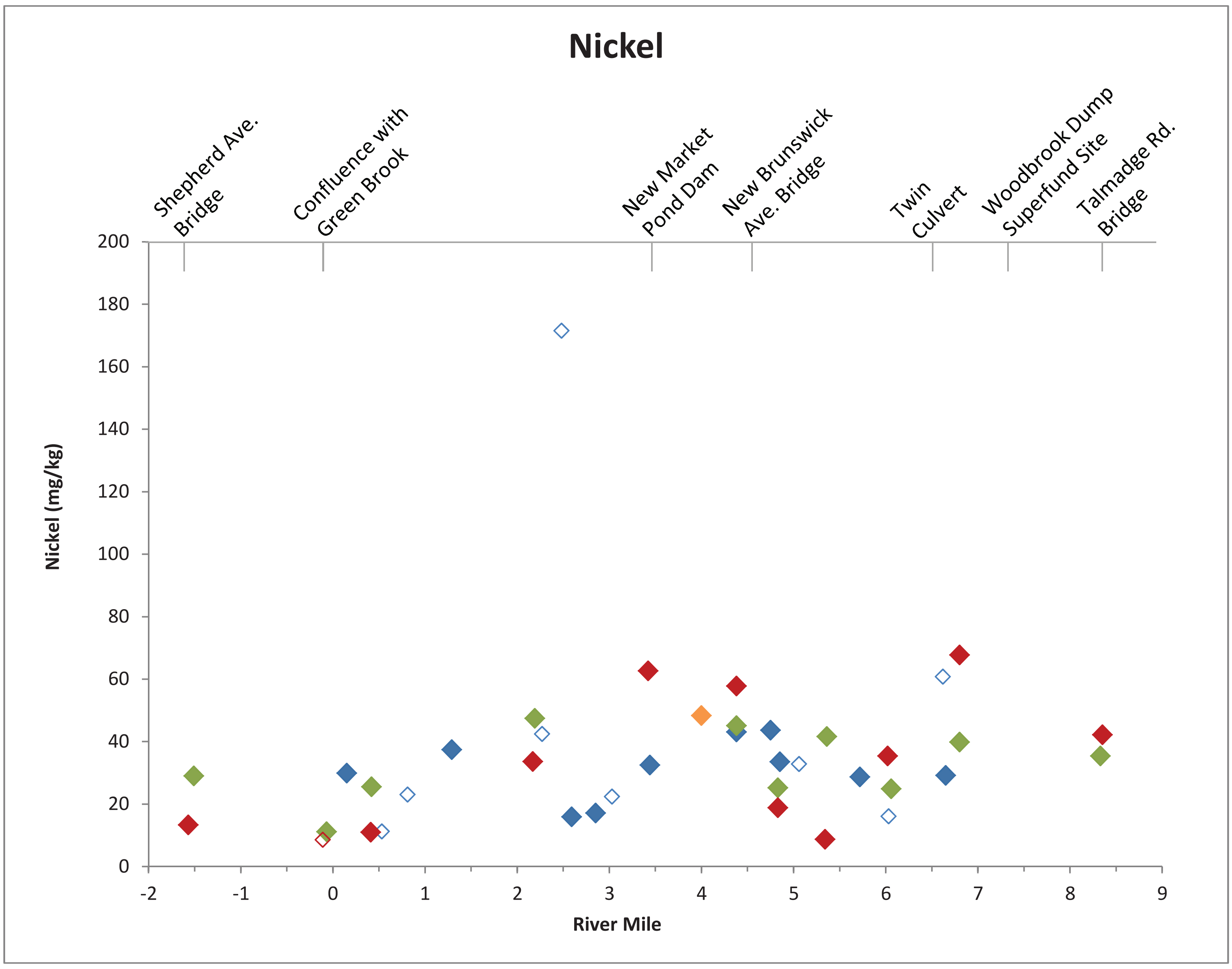


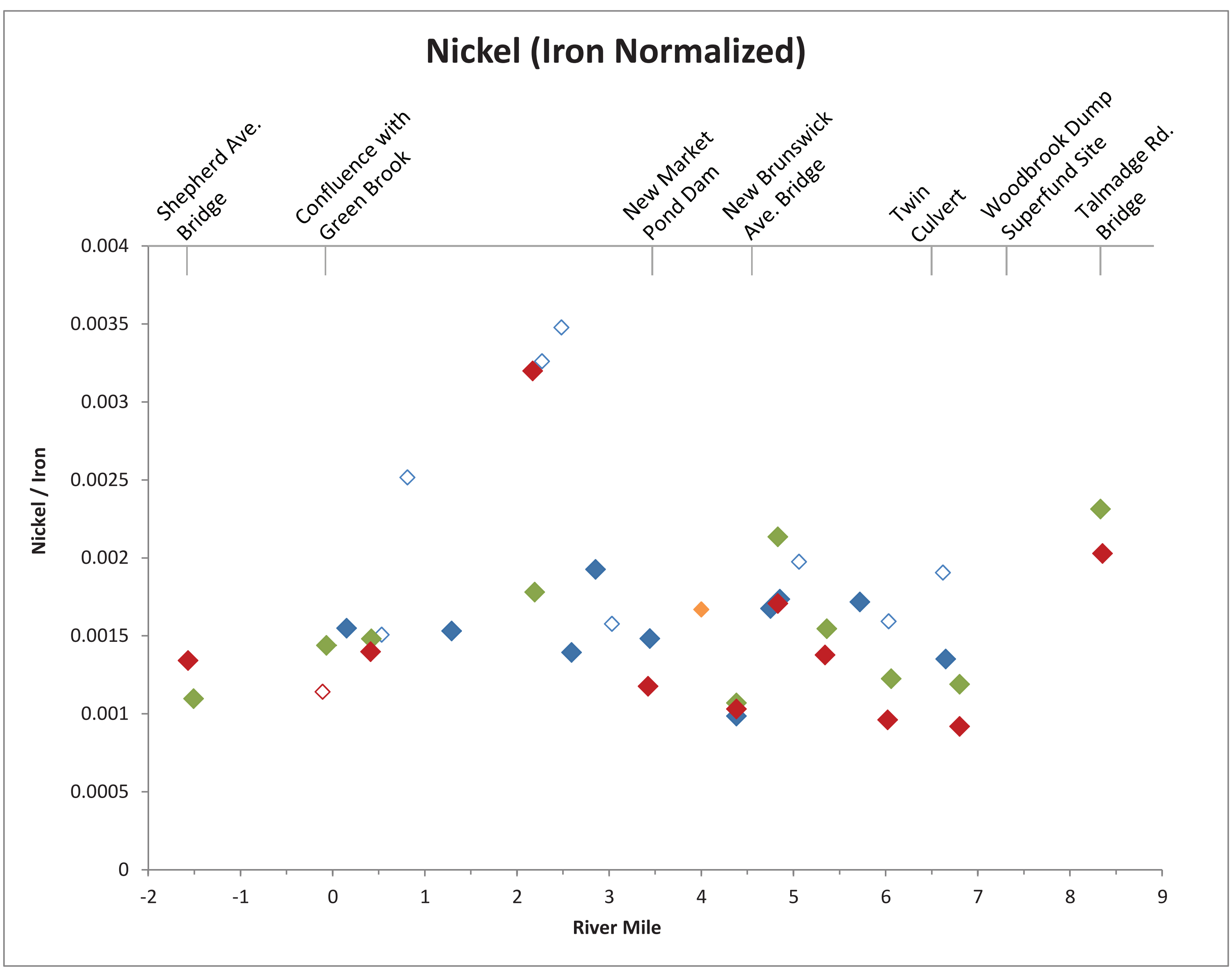
LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:

1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Concentrations in Recently Deposited Sediments (Mercury)** *Bound Brook OU4 RI/FS*	2014	FIGURE 5-1h





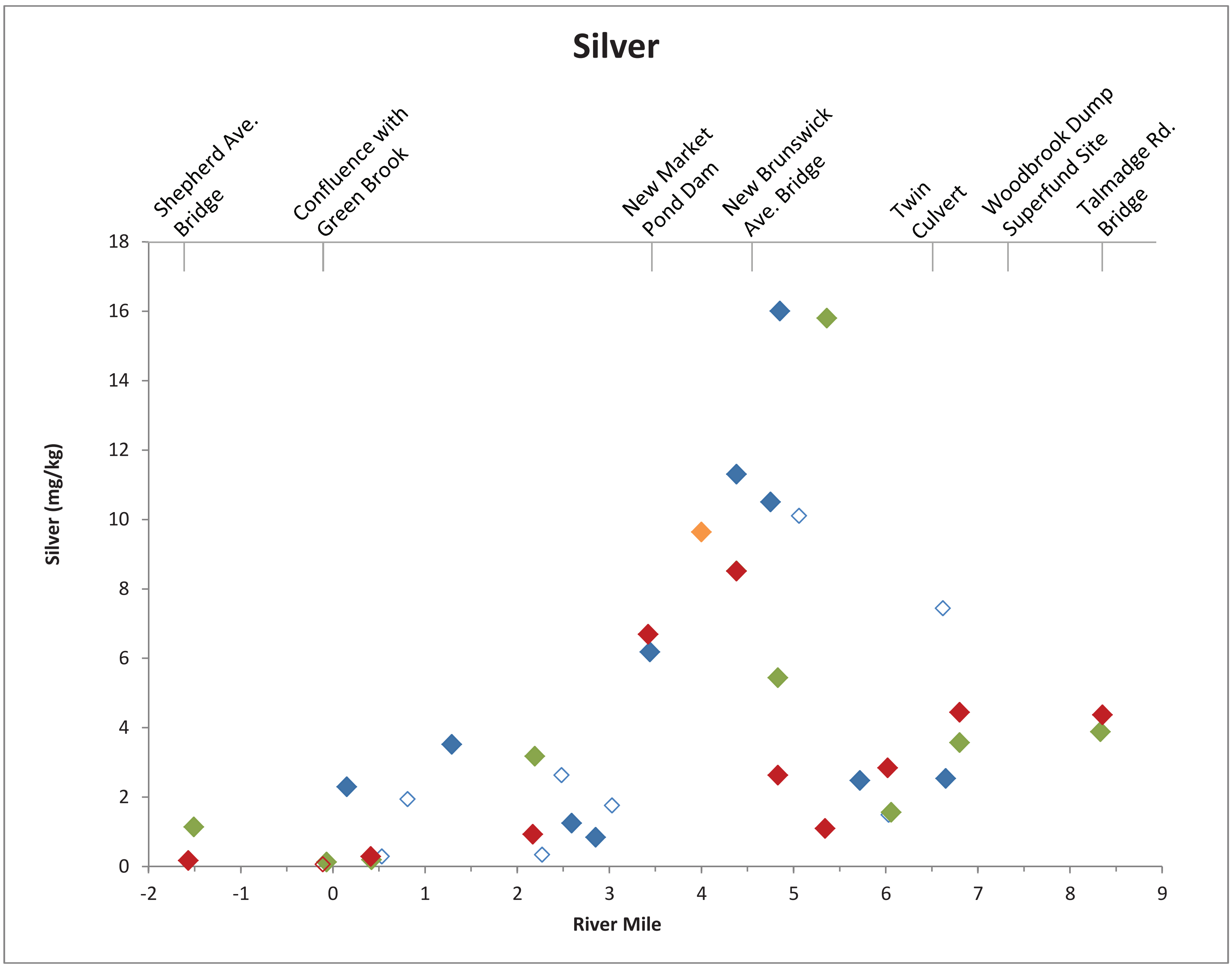
LEGEND:

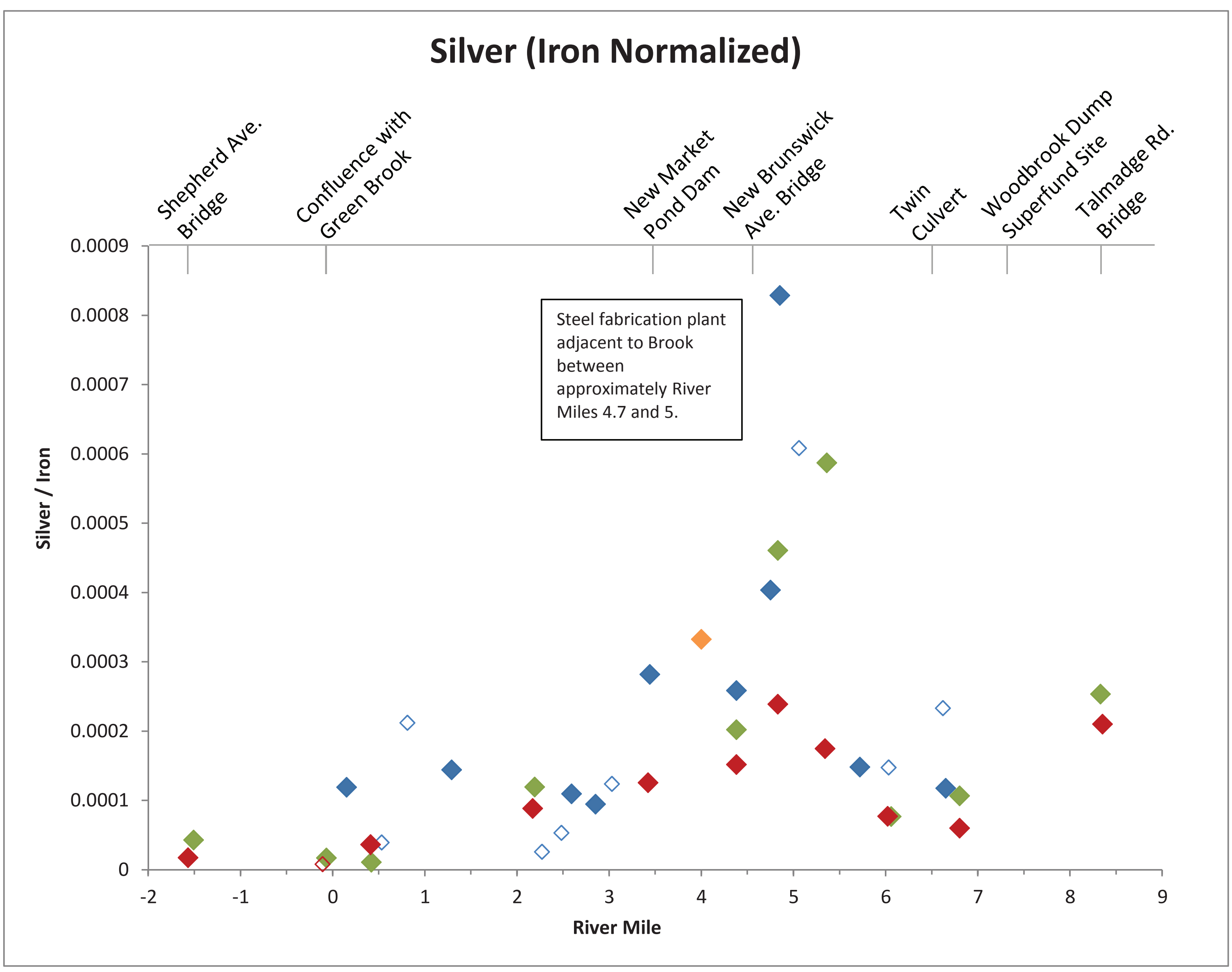
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:

1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Nickel)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1i

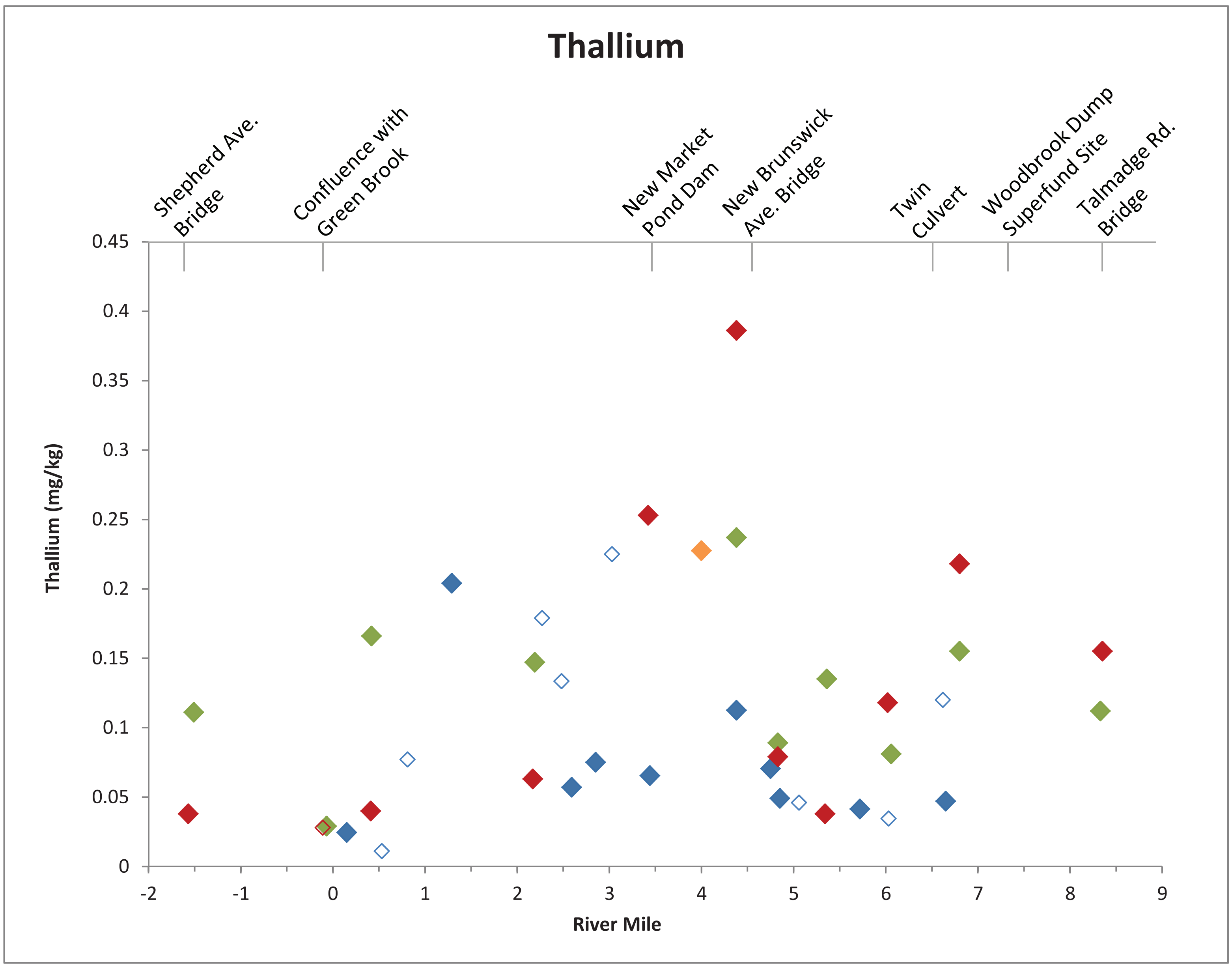


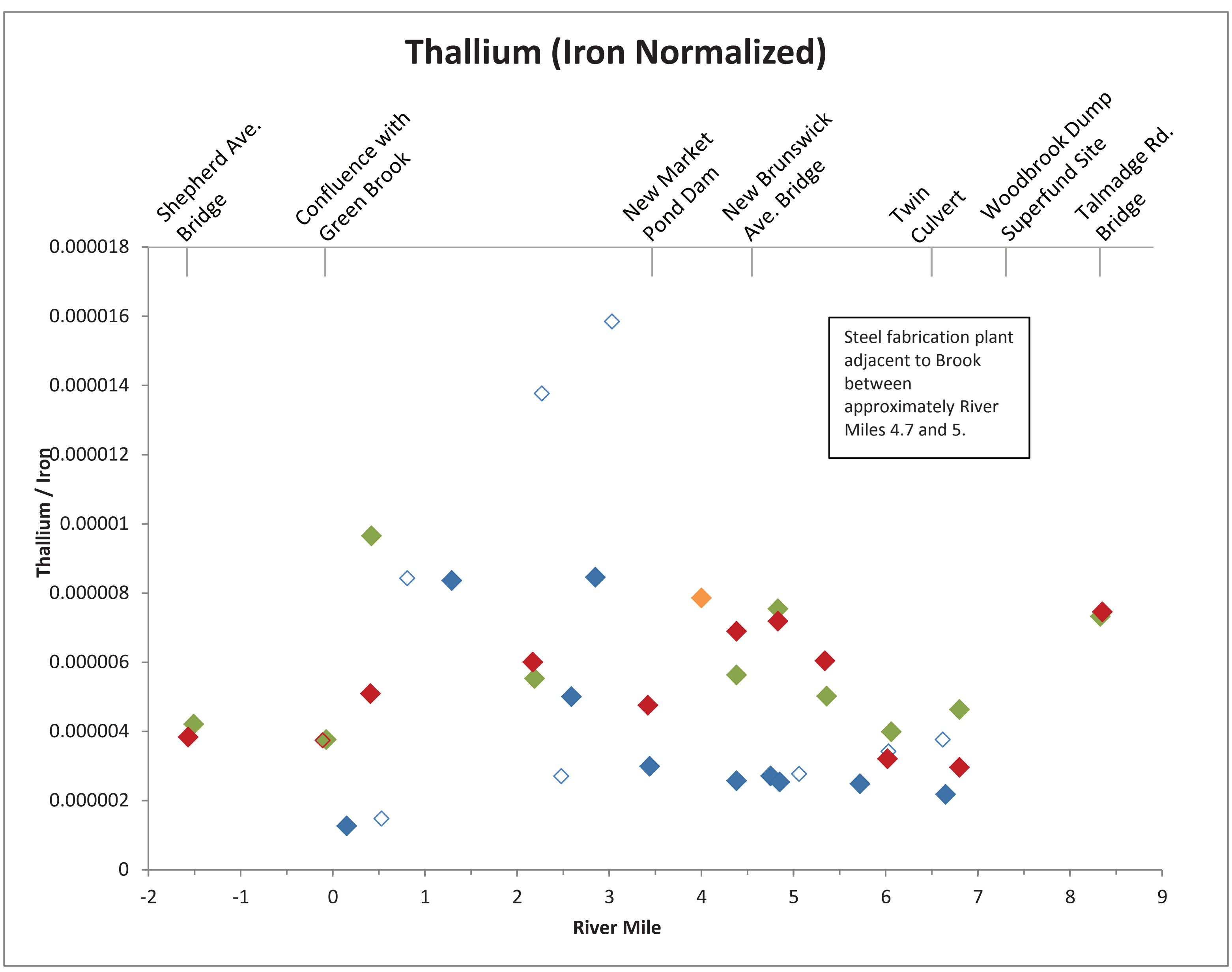


LEGEND:
- ◆ April 2011 Surface Sediment (Be7 bearing)
- ◇ April 2011 Surface Sediment (non-Be7 bearing)
- ◆ April 2011 High Resolution Core Top (Be7 bearing)
- ◆ Nov 2011 Surface Sediment (Be7 bearing)
- ◆ Nov 2011 Sediment Trap (Be7 bearing)
- ◇ Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Silver)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1j

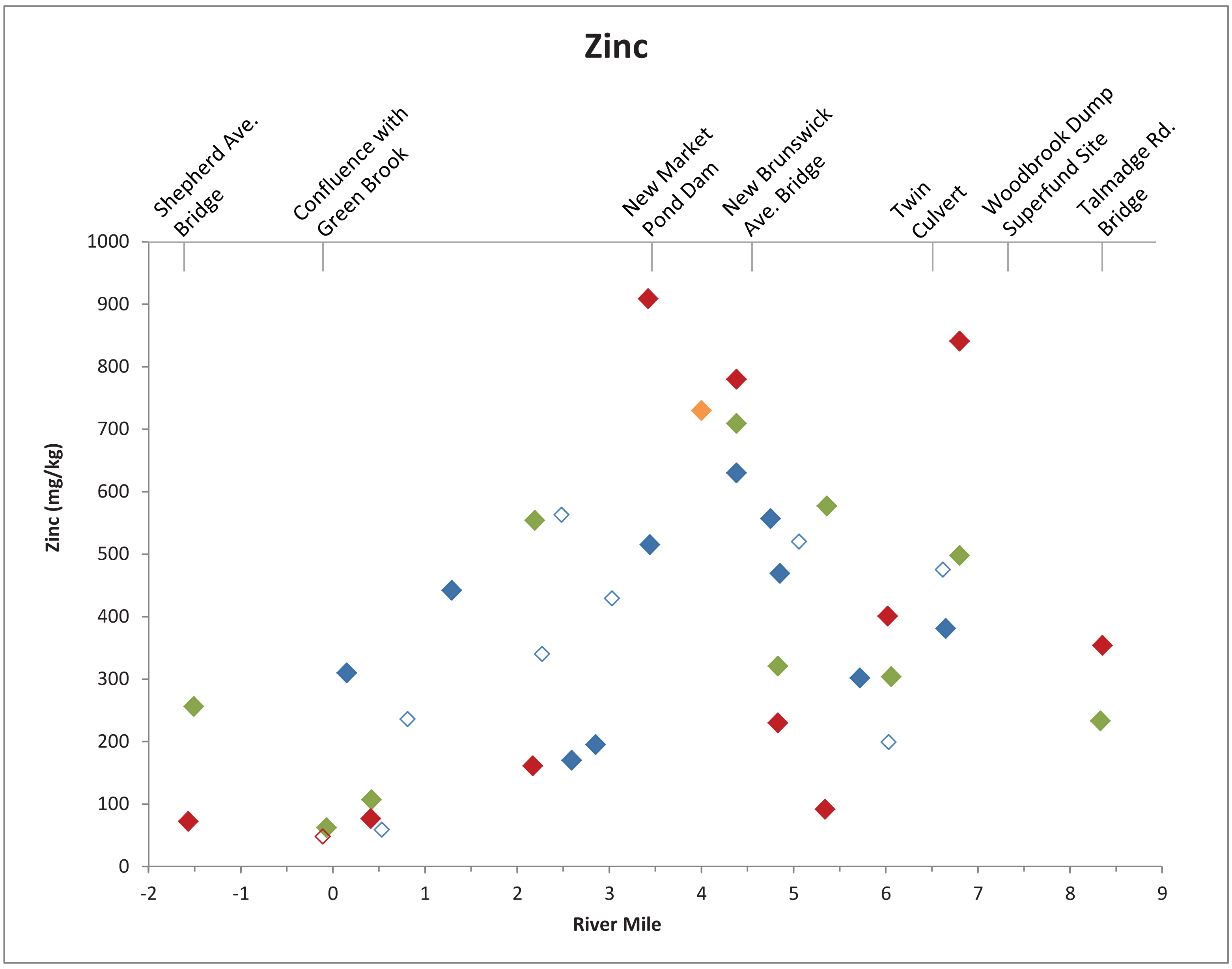


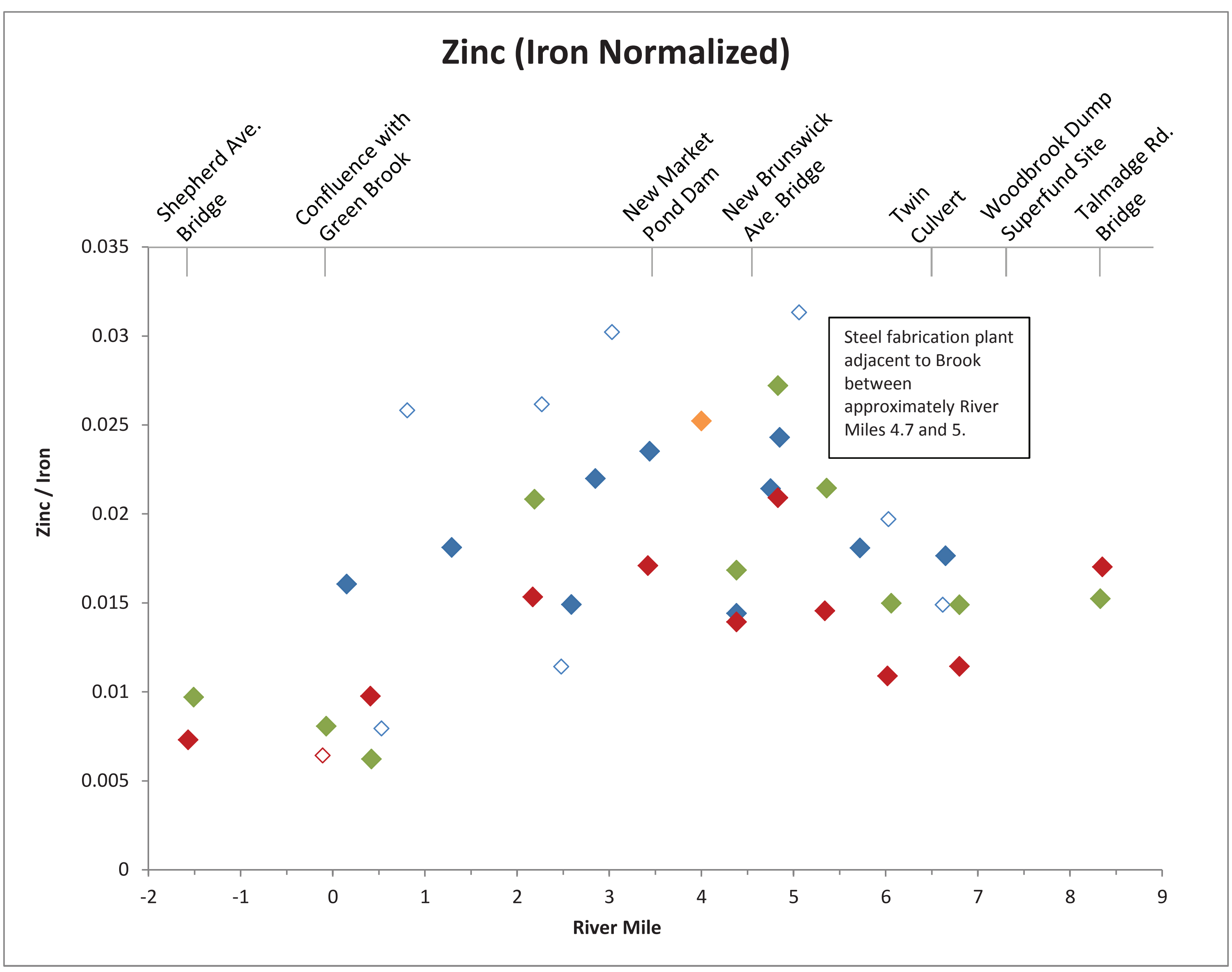


LEGEND:
- April 2011 Surface Sediment (Be7 bearing)
- April 2011 Surface Sediment (non-Be7 bearing)
- April 2011 High Resolution Core Top (Be7 bearing)
- Nov 2011 Surface Sediment (Be7 bearing)
- Nov 2011 Sediment Trap (Be7 bearing)
- Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:
1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Thallium)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1k



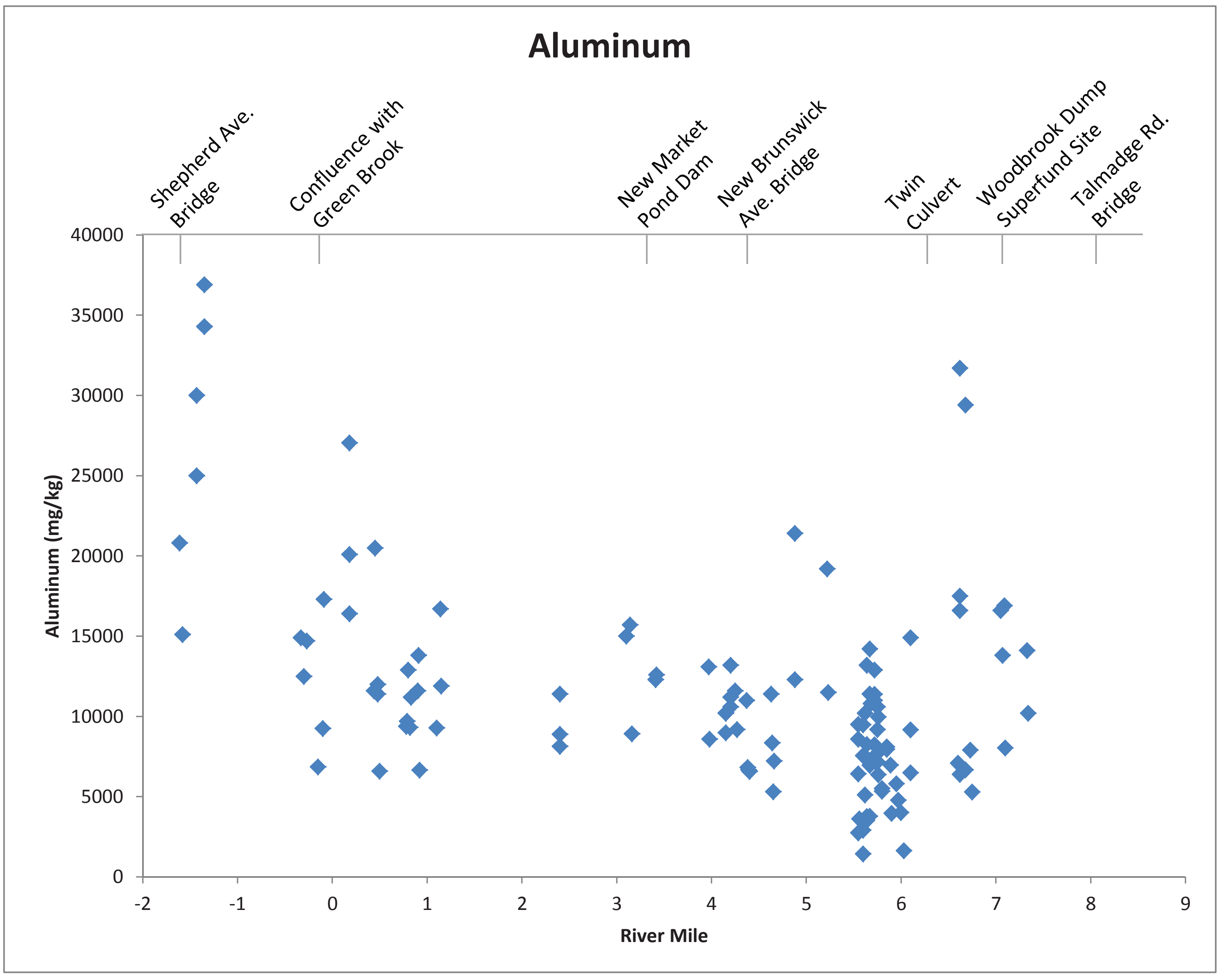


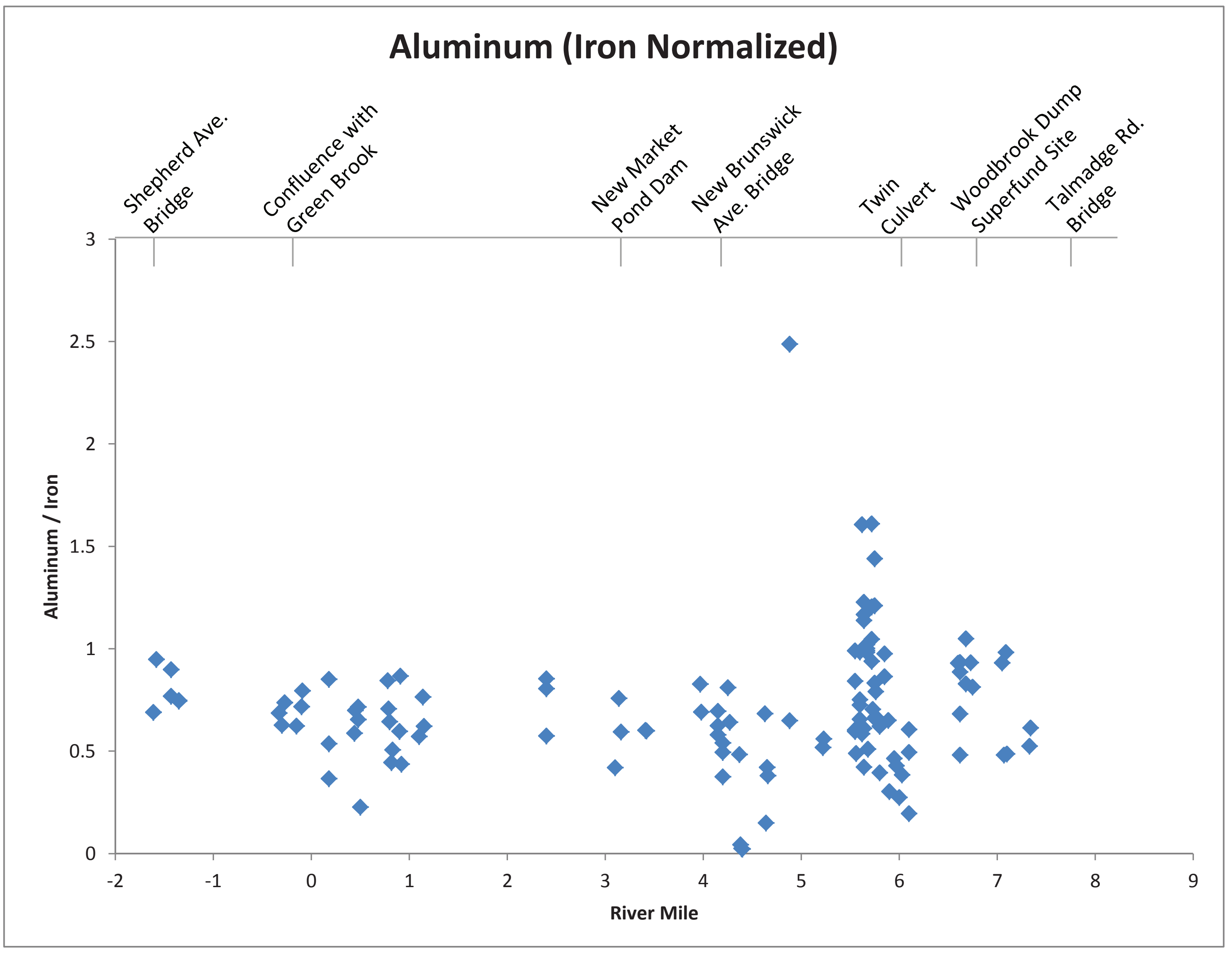
LEGEND:
- ◆ April 2011 Surface Sediment (Be7 bearing)
- ◇ April 2011 Surface Sediment (non-Be7 bearing)
- ◆ April 2011 High Resolution Core Top (Be7 bearing)
- ◆ Nov 2011 Surface Sediment (Be7 bearing)
- ◆ Nov 2011 Sediment Trap (Be7 bearing)
- ◇ Nov 2011 Sediment Trap (non-Be7 bearing)

NOTES:

1. Filled symbols indicate the presence of Be-7 at a concentration greater than 0.5 pCi/g; open symbols indicate a Be-7 concentration less than 0.5 pCi/g.
2. For samples with field duplicates, the average concentration is presented.
3. Nondetected concentrations are presented as half the method detection limit.
4. High resolution core top represents the average of the first two slices (0-6 cm total) since both slices were Be7 bearing and had a moisture content of approximately 70 percent.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Recently Deposited Sediments (Zinc)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-1l

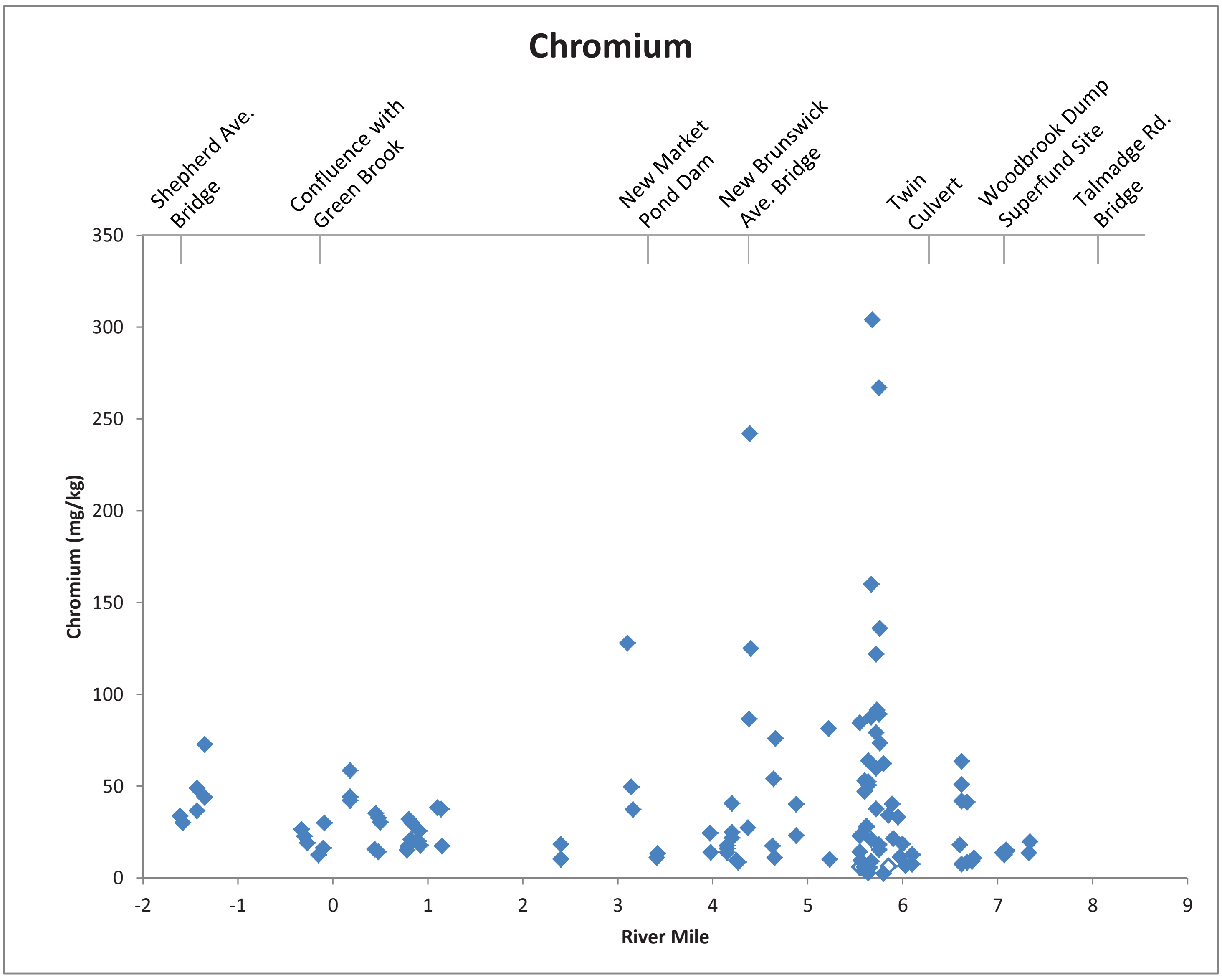


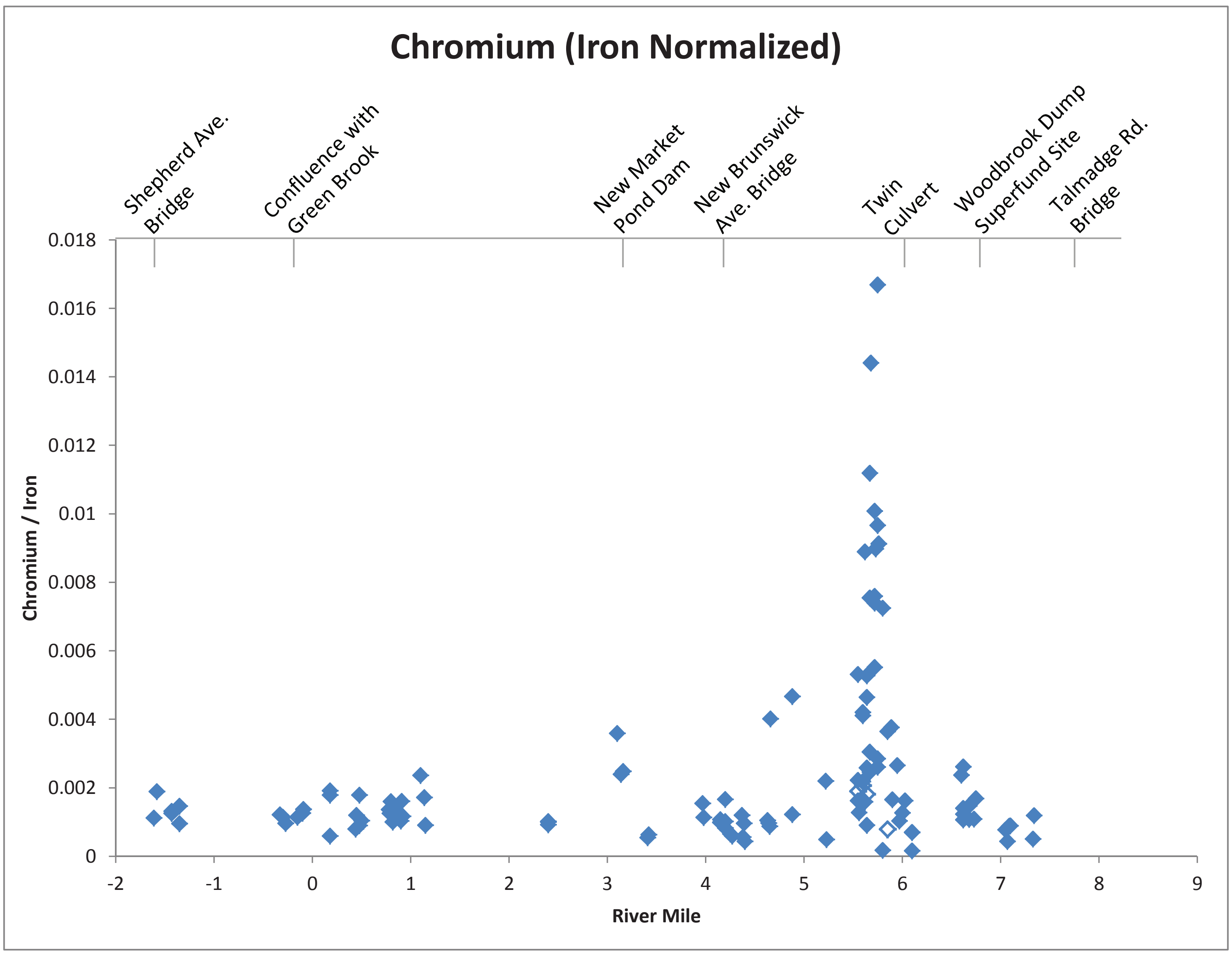


LEGEND:
- ◆ Floodplain Surface Soil - Detected Concentrations
- ◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:
1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils** **(Aluminum)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-2a





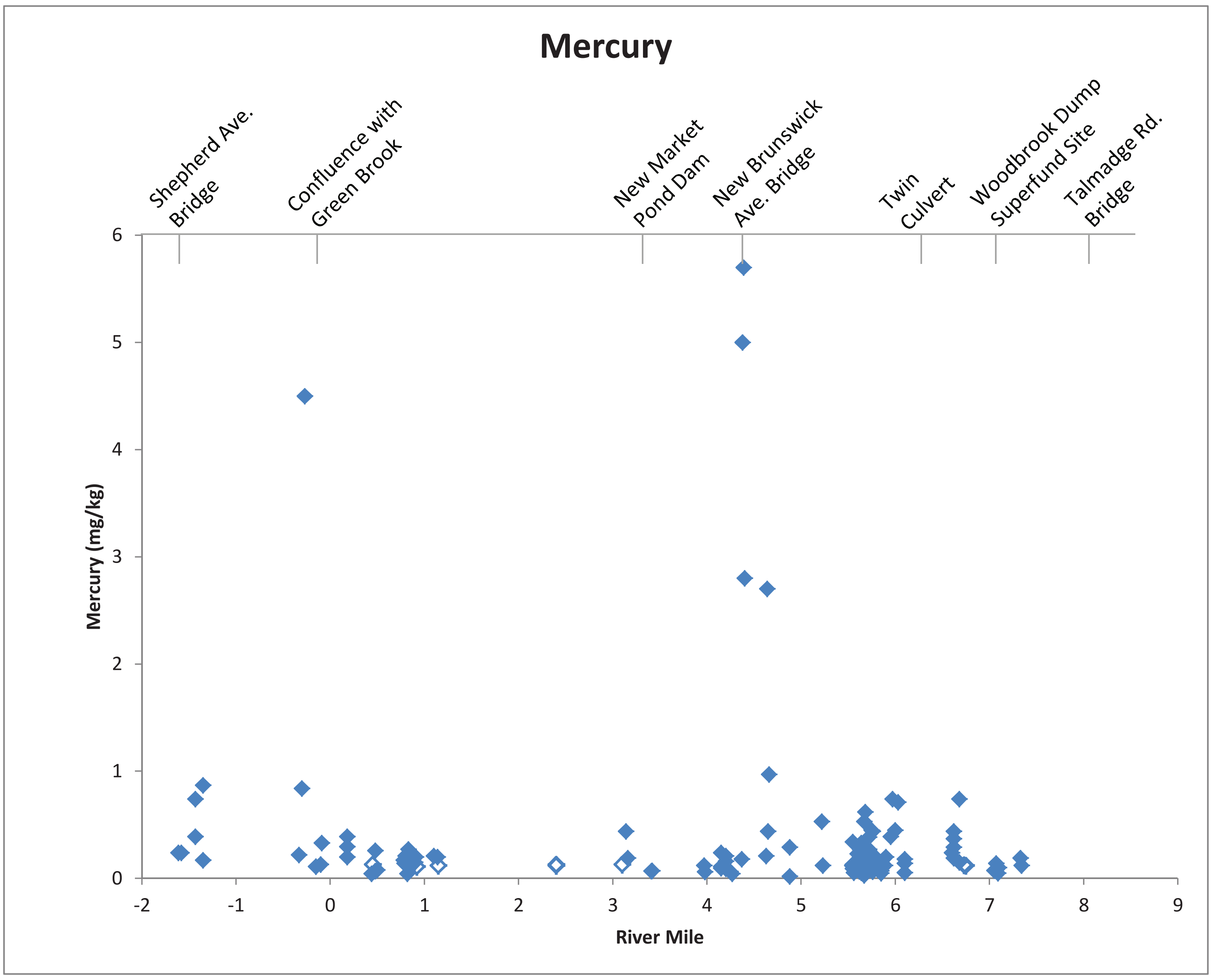
LEGEND:

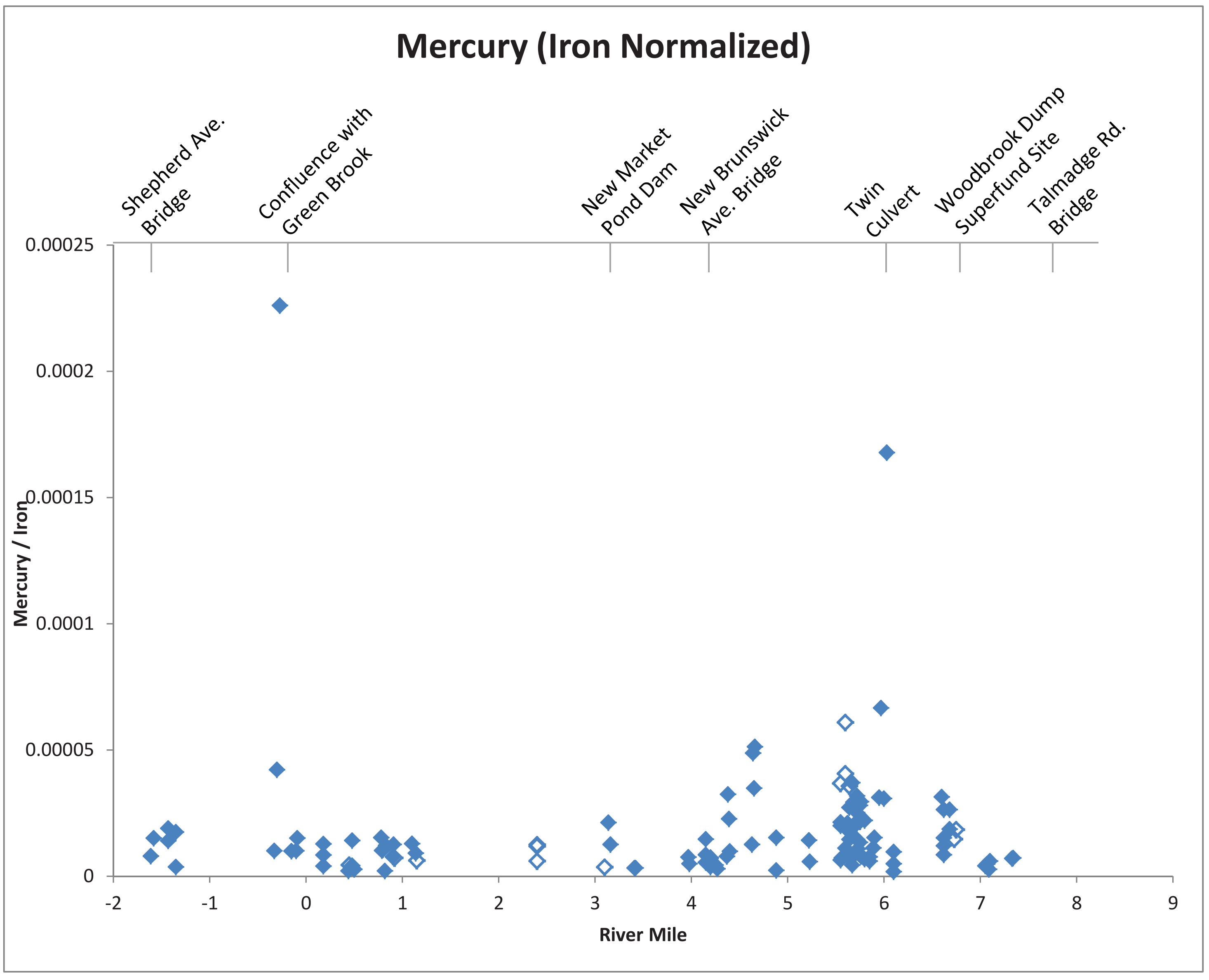
- ◆ Floodplain Surface Soil - Detected Concentrations
- ◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:

1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils (Chromium)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-2b

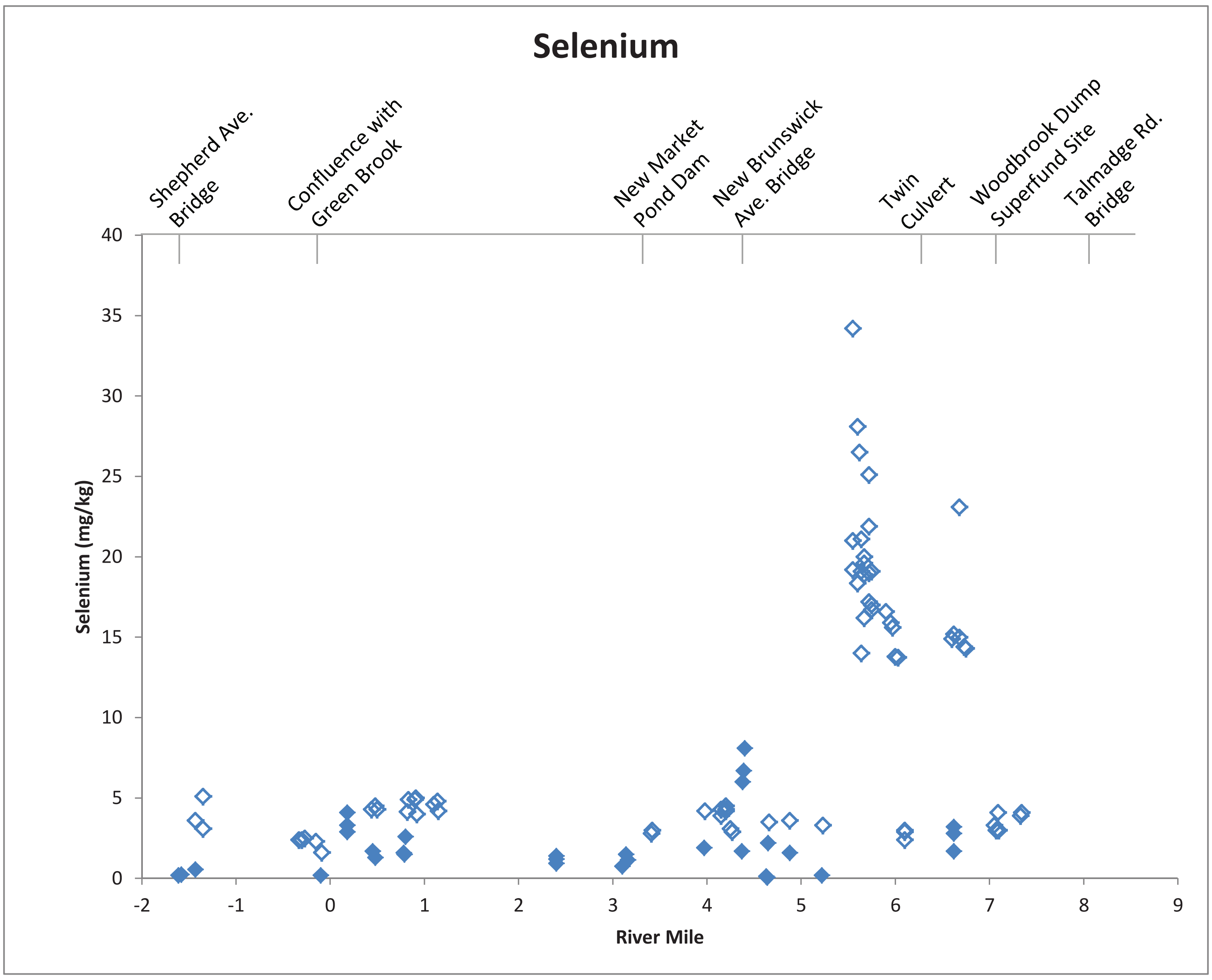


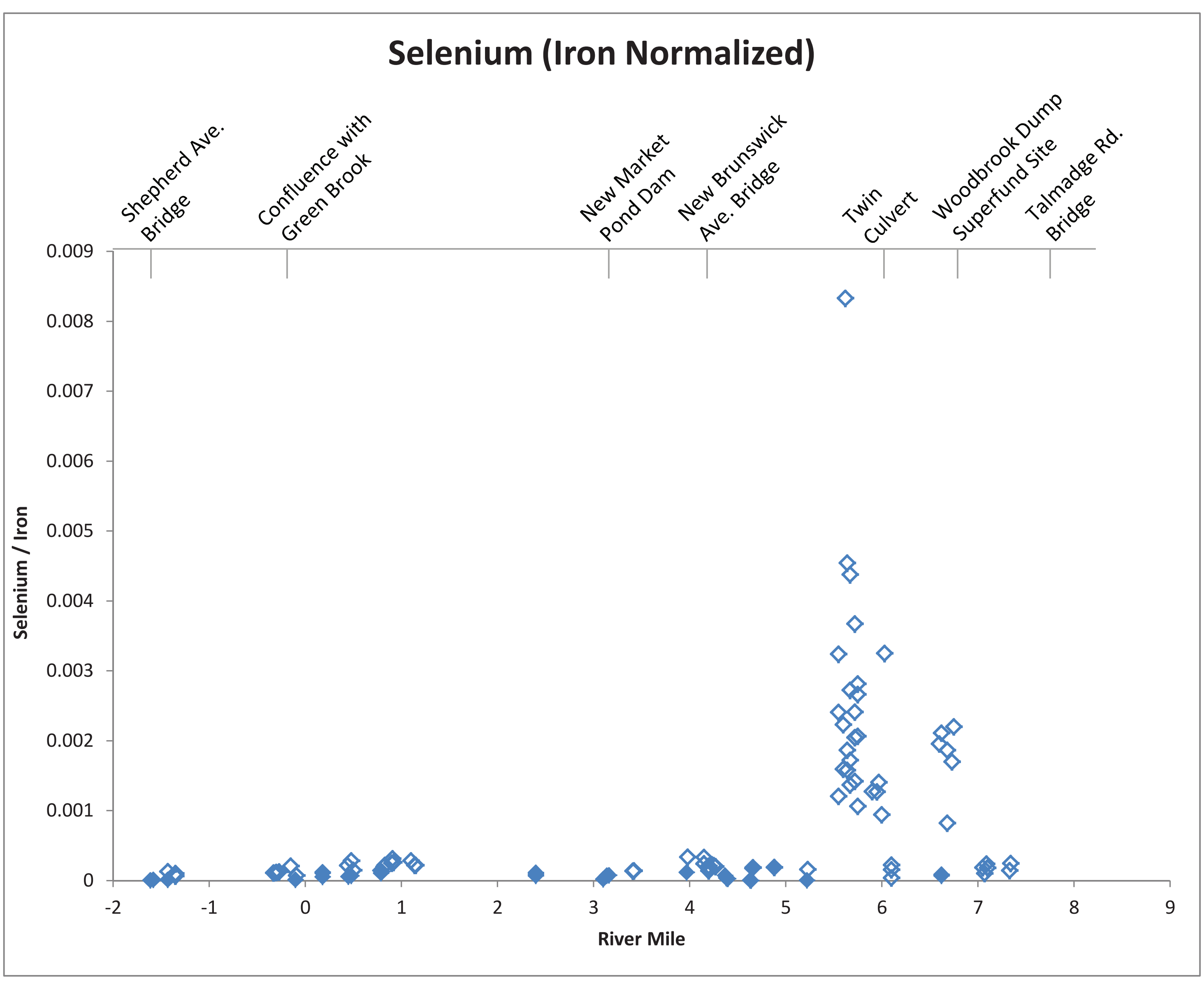


LEGEND:
- ◆ Floodplain Surface Soil - Detected Concentrations
- ◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:
1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils (Mercury)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-2c

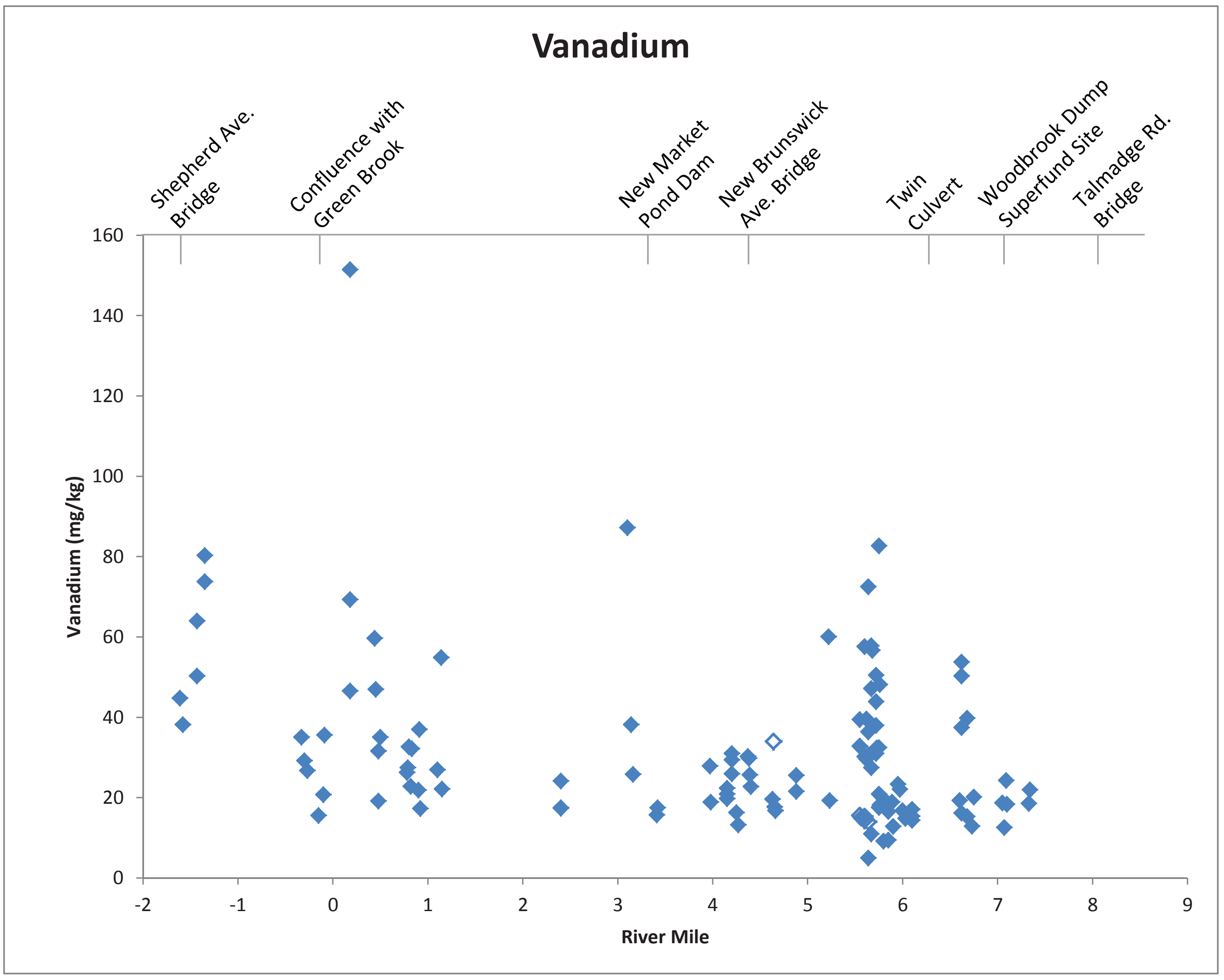


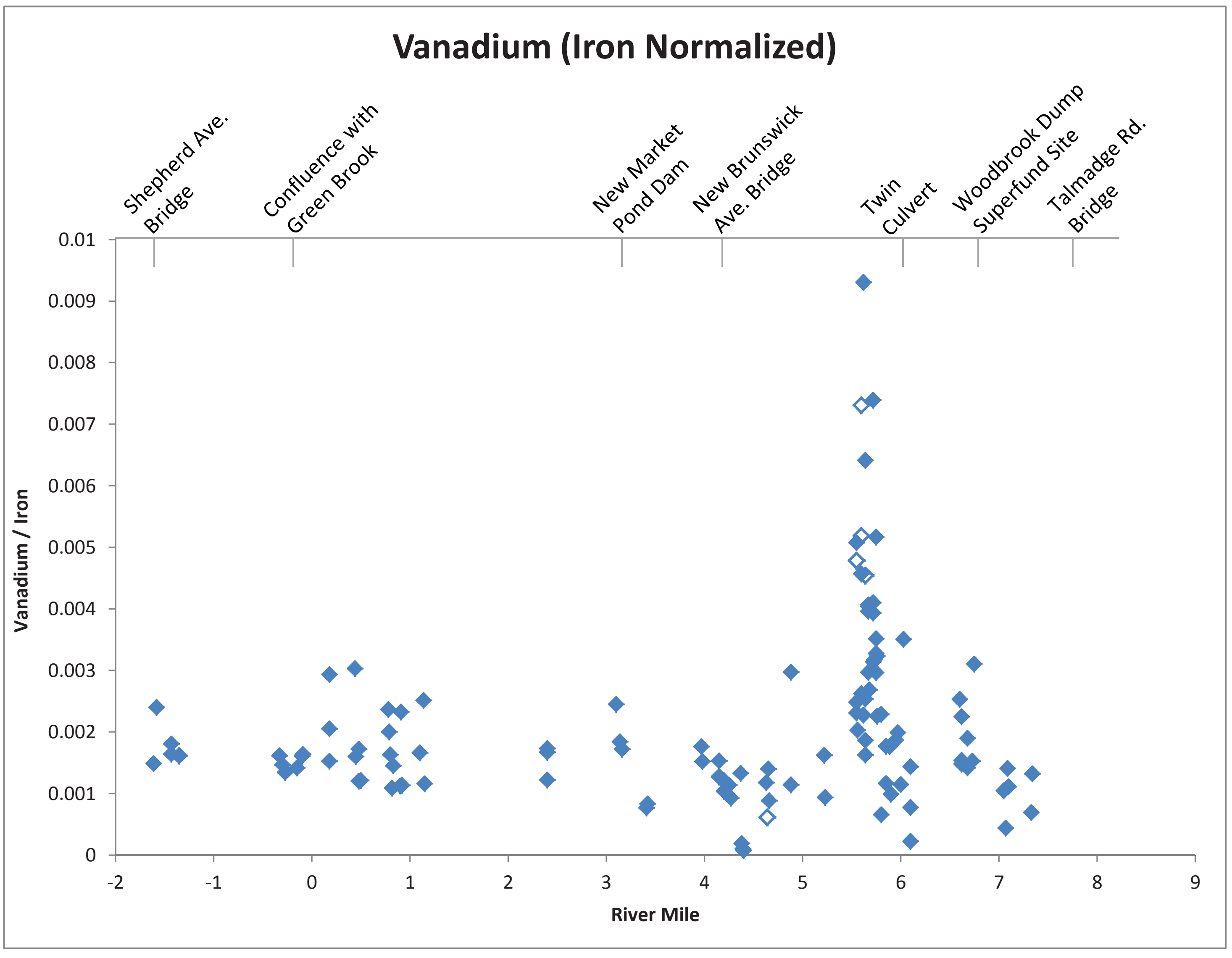


LEGEND:
- ◆ Floodplain Surface Soil - Detected Concentrations
- ◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:
1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils (Selenium)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-2d





LEGEND:

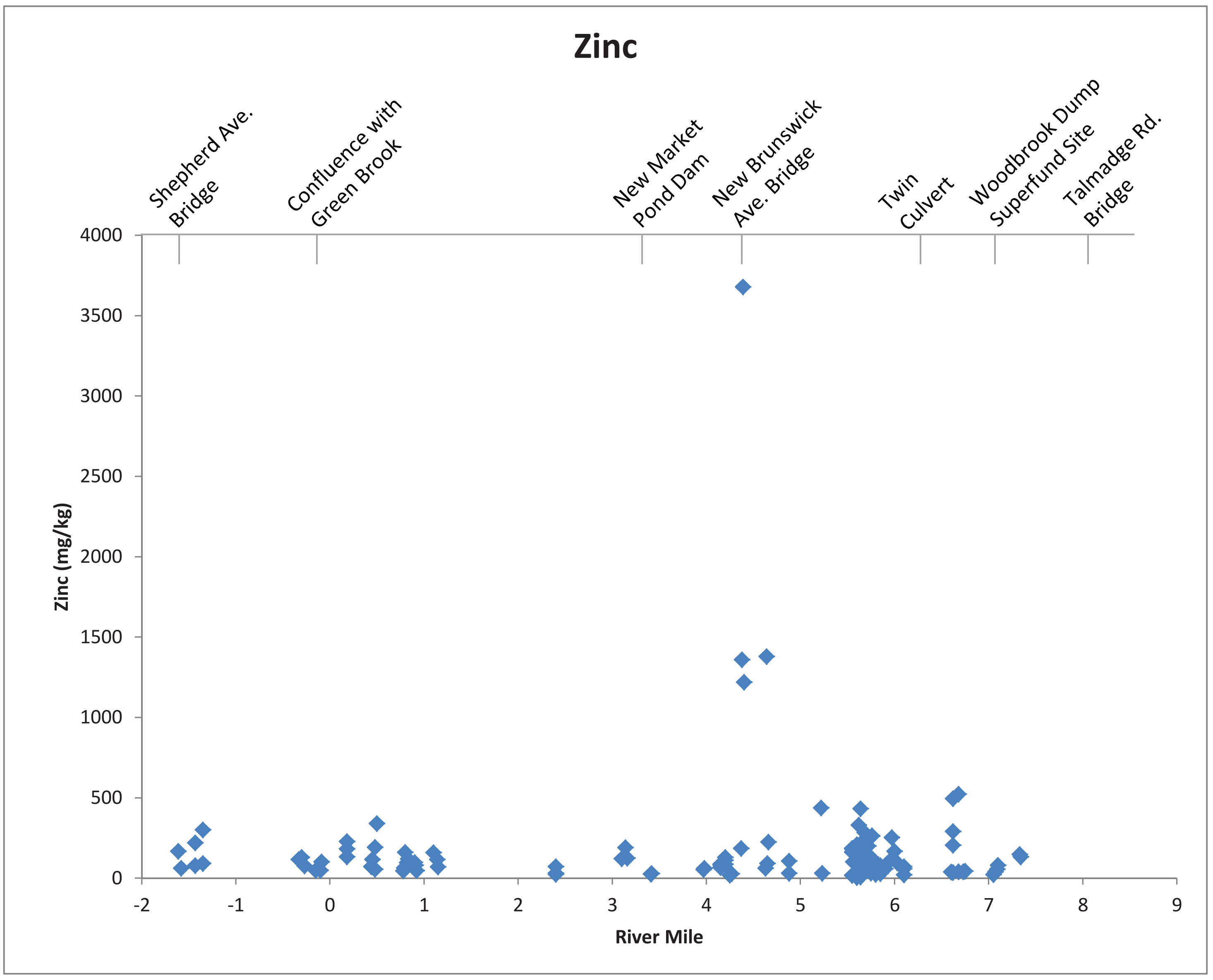
◆ Floodplain Surface Soil - Detected Concentrations

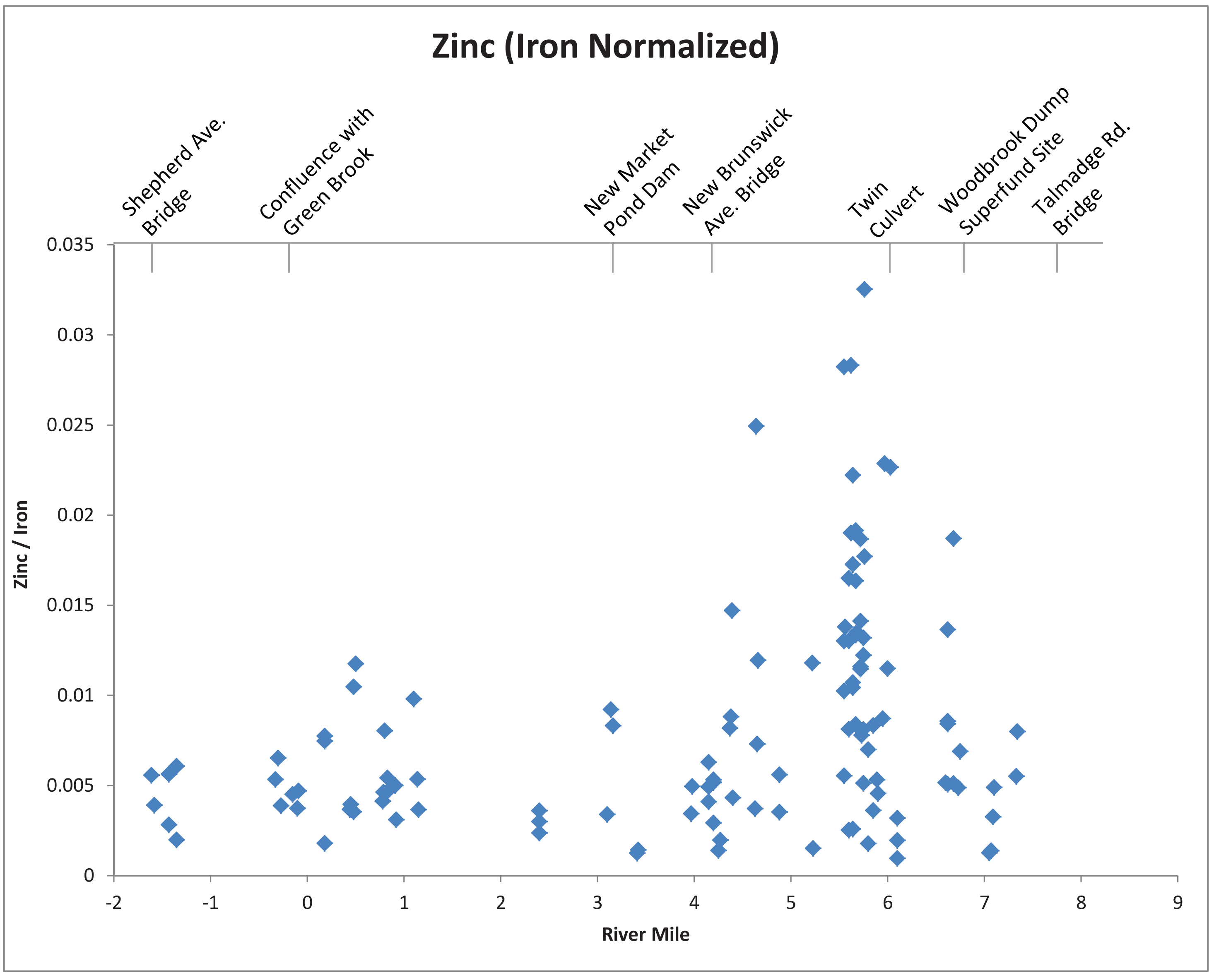
◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:

1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils (Vanadium)** *Bound Brook OU4 RI/FS*	2014	FIGURE 5-2e





LEGEND:

- ◆ Floodplain Surface Soil - Detected Concentrations
- ◇ Floodplain Surface Soil - Nondetected Concentrations

NOTES:

1. Floodplain surface soils were collected from gridded areas and transects between May 2011 and November 2011.
2. Floodplain surface soils represent an average depth of 0-31 cm below ground surface.
3. Filled symbols indicate detected concentrations; open symbols indicate nondetected concentrations.
4. Nondetected concentrations are presented as the reporting detection limit.
5. For samples with field duplicates, the average concentration is presented.

	Cornell-Dubilier Electronics Superfund Site South Plainfield, NJ	**Metals Concentrations in Floodplain Surface Soils (Zinc)** *Bound Brook OU4 RI/FS*	2014 FIGURE 5-2f